

## **APPENDIX A**

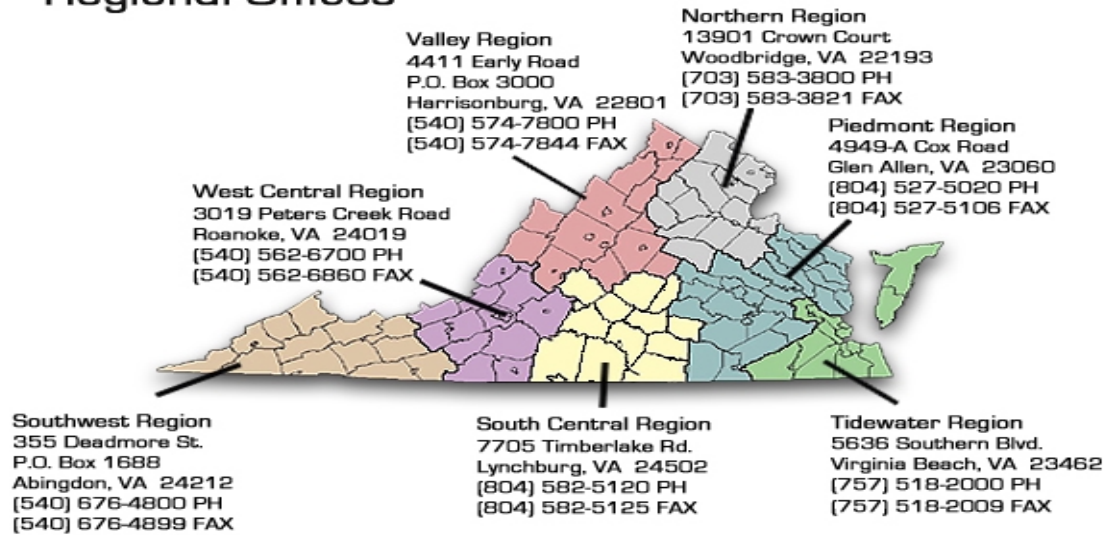
### **Regulated Substance List (Title III List of Lists)**

The Title III List of Lists is an EPA file created in Adobe Acrobat. The List of Lists is included with the technical manual as a separate file in PDF format. If you wish, you may obtain the List of Lists at the EPA WEB site  
<http://www.epa.gov/CEPPO/pubs/title3.pdf>.

## **APPENDIX B**

### **Map of DEQ Regions**

## Virginia Department of Environmental Quality Regional Offices



### Regional Offices

### Counties and Cities

Regional Offices	Counties and Cities
<b>Northern Regional Office</b>	<p><b>Counties</b> Arlington, Caroline, Culpeper, Fairfax, Fauquier, King George, Loudoun, Madison, Orange, Prince William, Rappahannock, Spotsylvania, Stafford, Louisa</p> <p><b>Cities</b> Alexandria, Falls Church, Fairfax, Fredericksburg, Manassas, Manassas Park</p>
<b>Piedmont Regional Office</b>	<p><b>Counties</b> Amelia, Brunswick, Charles City, Chesterfield, Dinwiddie, Essex, Gloucester, Goochland, Greensville, Hanover, Henrico, King and Queen, King William, Lancaster, Mathews, Middlesex, New Kent, Northumberland, Powhatan, Prince George, Richmond, Surry, Sussex, Westmoreland</p> <p><b>Cities</b> Colonial Heights, Emporia, Hopewell, Petersburg, Richmond.</p>
<b>South Central Regional Office</b>	<p><b>Counties</b> Amherst, Appomattox, Buckingham, Campbell, Charlotte, Cumberland, Halifax, Lunenburg, Mecklenburg, Nottoway, Prince Edward, Pittsylvania</p> <p><b>Cities</b> Danville, Lynchburg</p>
<b>Valley Regional Office</b>	<p><b>Counties</b> Albemarle, Augusta, Bath, Clarke, Fluvanna, Frederick, Greene, Highland, Nelson, Page, Rockbridge, Rockingham, Shenandoah, Warren</p> <p><b>Cities</b> Buena Vista, Charlottesville, Harrisonburg, Lexington, Staunton, Waynesboro, Winchester</p>
<b>Southwest Regional Office</b>	<p><b>Counties</b> Bland, Buchanan, Carroll, Dickenson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, Wythe</p> <p><b>Cities</b> Bristol, Galax, Norton</p>
<b>West Central Regional Office</b>	<p><b>Counties</b> Alleghany, Bedford, Botetourt, Craig, Floyd, Franklin, Giles, Henry, Montgomery, Patrick, Pulaski, Roanoke</p> <p><b>Cities</b> Bedford, Clifton Forge, Covington, Martinsville, Radford, Roanoke, Salem</p>
<b>Tidewater Regional Office</b>	<p><b>Counties</b> Accomack, Isle of Wight, James City, Northampton, Southampton, York</p> <p><b>Cities</b> Chesapeake, Franklin, Hampton, Newport News, Norfolk, Portsmouth, Poquoson, Suffolk, Virginia Beach, Williamsburg</p>



## **APPENDIX C**

### **DEQ Storage Tank Program Fact Sheets**

## Fact Sheets: DEQ Storage Tank Program

Fact Sheet Title	Date of Latest Revision
Notification of Underground Storage Tanks (USTs)	4-30-01
Virginia Petroleum Storage Tank Fund (VPSTF)	4-24-01
Financial Responsibility for Underground and Aboveground Storage Tanks	5-11-01
Suspected Releases	5-30-00
Confirmed Releases	6-7-00
Responsible Person Determination (USTs)	4-18-01
Regulated Underground Storage Tank (UST) Closures	6-4-01
AST Closure Site Assessment	4-23-01
AST Permanent Closure	4-23-01
AST Temporary Closure	Deleted <sup>1</sup> 6-24-98
Reporting Requirements for Suspected or Confirmed Releases from Regulated USTs, Unregulated USTs, and ASTs	4-23-01
Elements of an Initial Abatement Report	2-10-98
Elements of a Corrective Action Plan	2-10-98
Elements of a Free Product Removal Report	2-10-98
Elements of a Site Characterization Report	2-10-98
Monitoring Well Abandonment	2-10-98
Managing Used Oil - Commercial Facilities	3-30-98
Managing Used Oil - Homeowners	3-30-98
Home Heating Oil Aboveground and Underground Storage Tanks	7-3-01

<sup>1</sup> Temporary closure of ASTs is not allowed under the Facility and AST Regulation that became effective on June 24, 1998.

# Virginia Department Of Environmental Quality (DEQ) Storage Tank Program

## Fact Sheet: Notification of Underground Storage Tanks (USTs)

Anyone who owns a regulated UST must notify DEQ of the existence of the UST. Anyone who has knowledge of a regulated UST on their property (abandoned or in use), whether or not they are the owner/operator (o/o), must notify DEQ of the existence of the UST.

An **owner** is:

- ▶ anyone who owned an UST system that was in use or brought into use on or after November 8, 1984.
- ▶ for an UST system that was in use before November 8, 1984, but not on or after that date, the owner would be the person who owned the system when the UST system was last used.

NOTE: The term "owner" does not include any person who, without participating in the management of an underground storage tank or being otherwise engaged in petroleum production, refining, and marketing, holds indicia of ownership primarily to protect the holder's security interest in the tank.

An **operator** is:

- ▶ any person in control of, or having responsibility for, the daily operation of an UST system.

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**Notification must be provided to DEQ for all regulated USTs** (regardless of the age of the tanks or if they are no longer in use)

**Regulated USTs, in general, are:**

- Commercial tanks containing regulated substances that have a storage capacity greater than 110 gallons;
- Farm or residential tanks used to store motor fuel that have a storage capacity greater than 1,100 gallons;

**NOTE:** This is an abbreviated list; the complete definition of UST can be found in the UST Technical Regulation 9 VAC 25-580-10.

To notify DEQ of the existence of an UST, complete a Notification for UST Form 7530-1 and send it to DEQ Central Office at the address listed below.

UST systems that were last used before December 22, 1988, (this is the date the Federal UST regulations became effective) and have not been used after that date, are considered closed. However, **notification must still be provided to DEQ**. If you know there are USTs on your property (regardless of the fact that they may be properly closed in place or no longer used), **you must notify DEQ**.

**A Notification for Underground Storage Tanks Form 7530-1 must be filed:**

1. Any time there is a change in:
  - ▶ ownership (sold property, name/company change, address changes, etc.);
  - ▶ tank status (closing a tank-permanently or temporarily);
  - ▶ tank/piping systems (upgrades);
  - ▶ substances stored (gasoline to kerosene, etc.).
2. Installation of new UST systems. Required installation documentation includes:
  - ▶ certification of tank installation (page 5 of Form 7530-1)
  - ▶ certification of release detection equipment and cathodic protection (for steel tanks and piping, Page 5 of Form 7530-1);
  - ▶ financial responsibility documentation (Page 2 of Form 7530-1).

**All Notification Forms MUST be sent to DEQ within 30 days of the change or installation of a new UST system.**

**Mail to:**  
**DEQ-UST Program**  
**P.O. Box 10009**  
**Richmond, VA 23240-0009**

# Virginia Department of Environmental Quality Storage Tank Program

## Fact Sheet: Virginia Petroleum Storage Tank Fund (VPSTF)

### Highlights:

- ▶ Financial responsibility requirements vary depending upon the type of tank (see the DEQ Reimbursement Guidance Manual).
- ▶ Only UST and AST owners, operators, or persons who have assumed liability for the release are eligible to request access to VPSTF. Exception: In some instances, lenders and the Virginia Dept. of Transportation are eligible to request access to VPSTF for tanks they did not own or operate.
- ▶ The VPSTF Reimbursement Claim Application Form must be used to request reimbursement from the VPSTF.
- ▶ DEQ must approve (authorize) all investigation work in advance using the **Activity Authorization Form**. DEQ must verify all work performed, using the Activity Authorization Form.
- ▶ Owners/Operators must pay a financial responsibility requirement for each petroleum/oil release. This amount will be deducted from approved costs before any reimbursement is paid.
- ▶ The VPSTF reimburses eligible costs above the financial responsibility requirement according to the usual and customary rate (UCR) schedule. It is the owner's responsibility to ensure that costs for any investigative work are usual and customary. For the corrective action (remediation) phase, the owner may need to acquire bids prior to awarding the contract for work if costs are not included on the UCR Schedule.
- ▶ All reimbursement and third party claims for a site must be received within 2 years after the date of the case closure letter order to be eligible for reimbursement.
- ▶ Over the last several years, claims have exceeded the revenue collected for VPSTF. The DEQ will defer the first \$10,000 of cleanup payments for each occurrence. Payment of this first \$10,000 in approved costs above the financial responsibility level will be delayed until funds become available.

### Reimbursement Procedures

- 1) The release must be reported to DEQ (immediately for ASTs and within 24 hours for USTs). Corrective actions taken prior to the release report (24 hours preceding the release report for USTs) will not be eligible for reimbursement.
- 2) An **Activity Authorization Form** must be signed and approved by the Regional Office (RO) staff before site work may commence.
- 3) Reimbursement Claim Applications may be filed at DEQ Central Office upon completion of one or more corrective action phases. Applications will not be accepted unless the corrective action phase has been completed and the appropriate report has been submitted to the RO.
- 4) The Reimbursement Package must include:
  - (a) all costs associated with the completed corrective action phase, listed on the AAF Cost Worksheet;
  - (b) the completed Reimbursement Claim Application (Form 1);
  - (c) a completed substitute IRS Form W-9 (only required with the first reimbursement claim)
  - (d) legible copies of all applicable receipts, invoices, billings, etc., for all costs included on the application.
- 5) The Reimbursement Package should be mailed to:

**DEQ - OSRR**  
**P.O. Box 10009**  
**Richmond, VA 23240-0009**
- 6) The AAF for the completed phase must be completed by filling in the "work performed" column and submitted to the Regional Office.

Please Note: In general, VPSTF does **not** reimburse costs for UST/AST closures (unless these actions are pre-authorized as part of corrective action). Please see the VPSTF Reimbursement Guidance Manual for additional information.

(Revised 4/24/01)



# Virginia Department of Environmental Quality Storage Tank Program

## Fact Sheet: Financial Responsibility for Underground and Aboveground Storage Tanks

### Highlights:

- Financial Responsibility (FR) requirements vary depending upon the type of tank (see Table 1, below).
- In the event of a release, owners and operators of petroleum tanks in Virginia must pay a FR requirement for each occurrence as their share of the cost of corrective action/cleanup.

Table 1: Financial Responsibility Access and Demonstration Requirements by Tank Type

Tank Type	Tank Definition	FR Requirement for Fund Access	FR Requirement For Demonstration
Regulated UST	tanks and/or piping more than 10% underground	See Table 2	See Table 2
Exempt UST 1	noncommercial (farm, residential) less than 1,100 gallon	\$500 (No third party)	n/a
Exempt UST 2	heating oil USTs	\$500 (No third party)	n/a
Regulated AST Facility	greater than 25,000 gallon storage capacity	AST Access Table (No third party)	Based on storage capacity
Unregulated AST Facility	less than 25,000 gallon storage capacity	AST Access Table (No third party)	n/a
Small Heating Oil AST	5,000 gallon or less heating oil AST	\$500 (No third party)	n/a

### Financial Responsibility Requirement for UST Owners/Operators

- 1) The amount of FR is determined on a sliding scale by calculating the total annual gallons pumped through all of the regulated USTs owned and operated in Virginia. Annual gallonage for used oil USTs must be included (This is calculated by the number of gallons pumped out of each tank annually.). At this time, only owners or operators of regulated USTs are required to demonstrate FR.
- 2) The amount of FR determined on the sliding scale is the amount that must be paid by an UST owner/operator before reimbursement from the Fund is allowed (see Table 2, below). This is also the amount of FR the UST owner/operator must demonstrate to operate these USTs legally in Virginia.
- 3) To demonstrate FR, the UST owner/operator must have proof of at least one of the following financial documents (in the form specified in the Appendices to 9 VAC 25-590-10 et seq.):
  - letter from chief financial officer (financial test)
  - trust agreement
  - insurance
  - a surety bond
  - guarantee
  - letter of credit
- 4) The UST owner/operator must use the exact language provided in the Appendices to 9 VAC 25-590-10 et seq.
- 5) This documentation is the proof that the owners/operators can pay their share of corrective action and third party liability claim costs if a release occurs. It must be updated annually and retained by the UST owner (either at the facility, or at the corporate headquarters. However, if the corporate headquarters is not in Virginia, FR documentation must be kept at the facility).
- 6) DEQ must receive the original copy of the FR documentation within 30 days of reporting a release.

Table 2. UST Financial Responsibility Requirement Sliding Scale

Annual Throughput (gallons)	Corrective Action (per occurrence)	Third Party Liability (per occurrence)	Annual Aggregate (per occurrence)
600,000 or less	\$5,000	\$15,000	\$20,000
600,001 - 1.2M	\$10,000	\$30,000	\$40,000
1,200,001 - 1.8M	\$20,000	\$60,000	\$80,000
1,800,001 - 2.4M	\$30,000	\$120,000	\$150,000
Above 2.4M	\$50,000	\$150,000	\$200,000

## Fact Sheet: Financial Responsibility for Underground and Aboveground Storage Tanks

### Financial Responsibility Requirement for AST Operators

1. The Aboveground Storage Tank and Pipeline Facility Financial Responsibility Requirements Regulation, 9 VAC 25-640-10 *et seq.* became effective on March 2, 2001.
2. Operators of facilities with a storage capacity greater than 25,000 gallons are required to demonstrate per occurrence and annual aggregate Financial Responsibility (FR) for containment and cleanup of discharges of oil.
3. The amount of FR is five cents per gallon of the aggregate aboveground storage capacity for ASTs in all Virginia facilities up to a maximum of \$ 1,000,000.
4. To demonstrate FR, AST operators must have proof of at least one of the following financial documents (in the form specified in the Appendices to 9 VAC 25-640-10 *et seq.*)
  - letter from chief financial officer (financial test)
  - surety bond w/ standby trust
  - trust agreement
  - guarantee
  - insurance
  - letter of credit w/ standby trust
5. The AST operator must use the exact language provided in the Appendices to 9 VAC 25-640-10 *et seq.*
6. This documentation is proof that the operators can pay their share of the corrective action costs if a discharge occurs. It must be updated annually and retained by the AST operator (either at the AST site or the operator's place of work in the Commonwealth).
7. AST operators may have one FR requirement for access to the Fund and another amount for demonstrating FR.
8. The operator's net annual profit determines how FR will be calculated for access to the Fund.
9. If the AST operator has less than \$10M in net annual profits, access to the Fund is based on the total storage capacity for the facility where the discharge occurs, rather than all facilities in Virginia (see Table 3.b below).
10. If the net annual profits are greater than \$10M, access to the Fund is based on the storage capacity for all AST facilities in Virginia (see Table 3.b below).

Table 3.a: AST Access for Cleanup Costs for Operator with Net Annual Profits Less than \$10 Million

Storage Capacity For the Facility Where Discharge Occurred	Financial Responsibility Requirement
Less than 25,000 gallons	\$2,500
25,000 - 100,000	\$5,000
100,000 - 4 M	Facility Storage Capacity x \$0.05 per gallon
Greater than 4 M	\$200,000

Table 3.b: AST Access for Cleanup Costs for Operator with Net Annual Profits of \$10 Million or More

Storage Capacity For All AST Facilities in VA	Financial Responsibility Requirement
Less than 4 M	\$200,000
4,000,001 - 19,999,999M	Total Storage Capacity for all Va. Facilities x \$0.05 per gallon
20 M or more	No Access

Please contact Renee Hooper at 804-698-4018 or Leslie Beckwith at 804-698-4123 if you have any questions concerning your financial responsibility requirement or demonstrating financial responsibility.

# Virginia Department of Environmental Quality (DEQ) Storage Tank Program

## Fact Sheet: Suspected Releases

### Highlights:

- ▶ Suspected releases **must be reported to DEQ** (immediately for ASTs and within 24 hours for USTs).
- ▶ DEQ must pre-approve all release investigation activities to be eligible for reimbursement (this means a PC# must be assigned to this site).
- ▶ Requests for site checks, tightness tests, etc., will be solicited by DEQ on a site specific basis.
- ▶ It is the owner/operator's responsibility to ensure that costs for any investigative work are usual and customary (See the DEQ UCR Schedule).

### Reasons for Suspecting a Release

- ▶ The discovery of free product, contaminated soil, contaminated groundwater, or vapors in the vicinity of the UST or AST system, including off-site impacts.
- ▶ Unusual UST operating conditions (such as problems with the pump dispenser, loss of product, water in the system).
- ▶ Monitoring results indicating that a release has occurred (unless the equipment was found to be defective, or if using inventory control or manual tank gauging, a second set of results show a release has not occurred).
- ▶ Statistical Inventory Reconciliation results from two consecutive months are inconclusive or there are three inconclusive SIR results within a six month period.
- ▶ The conditions listed above are not observed and analytical results for any sample collected at the site is as follows:
  - Analytical results from samples collected during storage tank closure:
    - Storage tanks that contain petroleum
      - TPH - soil greater than or equal to 100 mg/kg
      - TPH - water greater than or equal to 1 mg/l
      - All other petroleum constituents greater than the detection limit
    - Regulated USTs containing non-petroleum regulated substances
      - Analytical results for the substance stored in the tank that exceed the detection limit for that substance.
  - Analytical results from samples collected at any time other than storage tank closure:
    - Any concentration of petroleum or a regulated substance that exceeds the detection limit for that substance.

### Release Investigation Report

- 1) An **Activity Authorization Form** must be completed and approved by the Regional Office (RO) prior to any investigative work. Typical requirements for confirming or refuting a release may include (but are not limited to):
  - (a) A topographic map indicating site location;
  - (b) A complete and detailed site map:
    - including scale, north arrow, and legend;
    - including all buildings, roads, and adjacent properties;
    - clearly showing the tank system (including pipelines, pumps, former tank basins, etc.);
    - showing proposed soil sample and monitor well locations;
    - providing any risk information (potential receptors, e.g., wells, basements, surface water, etc.).
  - (c) Information and documentation pertaining to current release detection employed at the facility;
  - (d) Soil, groundwater, or surface water sampling;
  - (e) Tightness test;
  - (f) Sensitive Receptor Survey;
  - (g) Geologic information (bedrock, soils, structures, etc.).
- 2) When you report a suspected release, the DEQ will send a letter outlining the requirements for this investigation and will furnish a due date for the Release Investigation Report. Deadlines will be issued in consideration of the work requested and site specific conditions. Deadline extensions will be granted only when deemed warranted by DEQ staff.

# Virginia Department of Environmental Quality (DEQ) Storage Tank Program

## Fact Sheet: Confirmed Releases

### Highlights:

- ▶ Confirmed releases **must be reported to DEQ** (immediately for ASTs and within 24 hours for USTs).
- ▶ DEQ must pre-approve all site investigation and corrective action activities on the Activity Authorization Form (a PC# must be assigned).
- ▶ Corrective action requirements are site specific and risk-based.
- ▶ It is the tank owner/operator's responsibility to ensure that costs for any investigative and corrective action work are usual and customary (See the DEQ UCR Schedule).

### Pre-Approval of Site Investigation Work and Report Submittal

- 1) All site work must be pre-approved by the Regional Office (RO). If an acute hazard (fire, explosion, environmental emergency, etc.) exists at the site, the tank owner/operator must take immediate action to abate the hazard regardless of whether DEQ has pre-approved the necessary work.
- 2) To be eligible for reimbursement, an Activity Authorization Package must be provided to the RO as soon as possible after reporting a release. This package may be mailed or faxed to the RO.

#### **The Activity Authorization Package consists of:**

- (A) A USGS topographic map indicating site location;
  - (B) A complete and detailed site map:
    - including scale, north arrow, and legend;
    - including all buildings, roads, underground utilities, and adjacent properties;
    - clearly showing the tank system (including pipelines, pumps, former tank basins, etc.);
    - showing proposed soil sample and monitor well locations;
    - providing any risk information (potential receptors; e.g. wells, basements, surface water, etc.).
  - (C) The proposed Activity Authorization Form (please use black ink if faxing).
- 3) Once the Activity Authorization Package is approved and signed by the RO, site work may begin. Deadlines for specific reports will be issued by the RO. Deadlines will be issued in consideration of the work requested and site specific conditions. Deadline extensions will only be granted when deemed warranted by the DEQ staff.
  - 4) If the RO requests an Initial Abatement Report, please include:
    - a brief description of the release;
    - any relevant site information;
    - appropriate site maps and/or figures;
    - all steps taken to abate the release (hazard mitigation, prevention of further release, free product removal, etc.);
    - a completed AAF (approved by the RO, with work performed column filled out).
  - 5) If the RO requests a Site Characterization Report (SCR), please follow the general steps outlined in the "Elements of a Site Characterization Report" Fact Sheet. If the RO requests a limited or site specific SCR, include only the steps requested by the RO. A completed AAF (approved by the RO, the work performed column filled out) must be included with the SCR.

# Virginia Department of Environmental Quality (DEQ) Storage Tank Program

## Fact Sheet: Responsible Person Determination (USTs)

Owners and Operators are both considered to be Responsible Persons. Both are equally liable for investigative and/or cleanup costs.

An **owner** is:

- ▶ anyone who owned an underground storage tank (UST) system that was in use or brought into use on or after November 8, 1984.
- ▶ for an UST system that was in use before November 8, 1984, but not after that date, the owner would be the person who owned the system when the UST system was last used.

The term "owner" does not include any person who, without participating in the management of an UST or being otherwise engaged in petroleum production, refining, and marketing, holds indicia of ownership primarily to protect the holder's security interest in the tank.

An **operator** is:

- ▶ any person in control of, or having responsibility for, the daily operation of an UST system.

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In determining the Responsible Person, DEQ makes the following presumptions:

- 1) The release occurred at the time of discovery.
- 2) The UST owner listed on the UST Notification Form is the UST owner.
- 3) If DEQ has not received a Notification Form, the current property owner is the UST owner and is the Responsible Person for the necessary investigations and/or cleanup. **USTs are normally considered to be a fixture, transferred with land, unless an UST Notification Form, contract, bill of sale, or other written agreement exists that specifically states otherwise.**

**The burden is on the person DEQ considers the tank owner (UST owner listed on the Notification Form or current property owner if a Notification form was never submitted) to prove that another person is the Responsible Person using acceptable written evidence.**

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Documents that are acceptable to prove UST ownership:

- UST Notification Form filed with DEQ
- Document indicating someone else owns the UST
  - lease agreement
  - deed
  - bill of sale
  - service contract
  - court orders
  - bankruptcy proceedings
- Document such as a tax record or real estate appraisal showing discontinuation of use of the UST system prior to November 8, 1984.
- A Building Permit showing UST removal by prior owner and proof that no other UST has been in the same basin since the removal.
- A Building Permit showing UST removal by prior owner, documents indicating that a release occurred prior to removal (e.g. records from local fire or building officials, DEQ records), and a replaced UST exists on site (not in the same excavation), but has had no release.

As a general rule, affidavits alone are not acceptable in proving UST ownership.

(Revised 4/18/01)

# Virginia Department Of Environmental Quality (DEQ) Storage Tank Program

## Fact Sheet: Regulated Underground Storage Tank (UST) Closures

### Steps to Follow:

1. Contact the local building official (or designated fire official) and obtain a building permit. The building official **usually will be on site** during the removal of the tank system.
2. The tank and associated pipes must be drained, cleaned, and completely emptied. Precautions must be taken to mitigate vapor hazards (e.g. use of dry ice to purge vapors from the tank).
3. If the UST is closed in place (with prior approval from the building official), it **must** be drained of product, cleaned, and filled with an inert substance (e.g. cement slurry, sand). DEQ recommends that tanks be removed from the ground where possible.
4. Do **not over-excavate** the soil in the tank basin. Remove only the volume of soil needed to extract the tank from the subsurface.
5. A closure assessment is required in all cases (except where the UST has verifiable external vapor or ground water monitoring - see 9 VAC 25-580-330).  
**A closure assessment includes the following:**
  - a. A site map containing:
    - ▶ scale, north arrow, and legend;
    - ▶ all buildings and roads (labeled);
    - ▶ the entire UST system (this includes pipes and pump islands);
    - ▶ soil or water sample locations and depths; and
    - ▶ other important features including monitoring wells, drinking water wells, streams, etc.
  - b. Sample collection and analysis:
    - ▶ If obvious signs of contamination are present (e.g. free product, contaminated ground water, stained soil, etc.) the collection of samples is not necessary. Contact the Regional Office and report the release within 24 hours of discovery of a regulated substance in the environment.
    - ▶ If contamination is not obvious, **samples must be collected from locations where a release would most likely be detected if one occurred**. Soil samples must be collected from: the bottom of the UST basin; beneath the pipelines; under each pump dispenser; and any other area where contamination would be suspected. If ground water is encountered, soil samples should be collected from just above the soil - ground water interface.
    - ▶ All samples must be collected from discrete locations. Composite samples (mixtures of soil from different locations) are not acceptable.
    - ▶ Samples must be analyzed using EPA or DEQ **approved** methods.
    - ▶ If the tank contained petroleum, lab results for soil samples that equal or exceed 100 mg/kg TPH or water samples that equal or exceed 1 mg/l TPH must be reported to DEQ. If the tank contained a regulated substance (CERCLA listed substance) other than petroleum, analytical results that exceed the detection limit for that substance must be reported to DEQ within **24 hours**.
    - ▶ Results from vapor or ground water monitoring performed in accordance with section 330 of the UST Technical Regulation are acceptable in lieu of soil or ground water samples during UST closure. If, the results of monthly ground water or vapor monitoring are used in lieu of sample collection during UST closure, the monitoring results must be submitted along with the closure package.
  - c. Any additional information (photos, maps, notes from the building inspector concerning the closure, or any other documentation) that may help evaluate the closure.
6. A closure packet must be filed within 30 days of the tank closure. This closure packet must be sent to the DEQ Central Office, DEQ UST Program, P.O. Box 10009, Richmond, VA. 23240-0009.  
**The closure packet consists of:**
  - a. the completed and signed Notification Form 7530-1;
  - b. a copy of the building permit;
  - c. the closure assessment;
  - d. lab sheets from all analyses; and
  - e. copies of all disposal manifests (sludge, contaminated soil and/or water, UST).

Acceptable TPH Analytical Methods for Use During UST Closure		
Fuels	TPH Analytical Methods	Applicable Medium <sup>1</sup>
Gasoline and JP-4	California LUFT Method Wisconsin DNR - GRO SW 846 8015b (modified TPH - GRO)	w & s w & s w & s
Diesel, Fuel Oil #1 and #2, Jet Fuel <sup>2</sup> , Kerosene	California LUFT Method Wisconsin DNR - DRO SW 846 8015b (modified TPH - DRO)	w & s w & s w & s
Crude Oil, Fuel Oil #4, #5, and #6, Used Oil, Hydraulic Oil	EPA 413.1 EPA 413.2 EPA 418.1 Wisconsin TRPH	w s w & s s
<sup>1</sup> Applicable medium refers to the sample matrix that may be analyzed by the subject test method. "w" refers to an analytical method that may be used to analyze water "s" refers to an analytical method that may be used to analyze soil  <sup>2</sup> JP-4 is a wide-cut fuel made by blending gasoline and kerosene fractions in a 65 to 35 ratio.  References: EPA 100 – 400 Series – Methods for Chemical Analysis of Water and Wastes, EPA – 600/4-79-020, March 1983 EPA SW-846 – Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Revision 5, April 1998 Publ. – SW - 140. Modified GRO, Method for Determining Gasoline Range Organics, Wisconsin DNR, September 1995. Publ. – SW – 141. Modified DRO, Method for Determining Diesel Range Organics, Wisconsin DNR, September 1995. Publ. – SW – 143. Wisconsin DNR, 1992		

If you have additional questions, persons in the storage tank program may be reached at the numbers listed below.

Central Office (Richmond)	(804) 698-4269
Tidewater Regional Office (VA. Beach)	(757) 518-2000
Northern VA. Regional Office (Woodbridge)	(703) 583-3800
Piedmont Regional Office (Richmond)	(804) 527-5020
Valley Regional Office (Harrisonburg)	(540) 574-7800
West Central Regional Office (Roanoke)	(540) 562-6700
Southwest Regional Office (Abingdon)	(540) 676-4800
South Central Regional Office (Lynchburg)	(804) 582-5120

# **Virginia Department Of Environmental Quality (DEQ) Storage Tank Program**

## **Fact Sheet: AST Closure Site Assessment**

Observation of any oil contaminated ground water, oil contaminated soil, and/or free product must be reported as a confirmed release by the AST operator to DEQ immediately (Regional Office phone numbers are listed below). Site Characterization and remediation may be required by DEQ in addition to the requirements listed below. Note: include the assigned pollution complaint (PC) number in documentation below.

### **REQUIRES AST SITE ASSESSMENT**

- ▶ Permanent closure (all cases)
- ▶ DEQ, building official or designee request

### **SOIL SAMPLING**

Operators shall sample and test for total petroleum hydrocarbons in any area where contamination is likely to have occurred.

- ▶ around AST and piping
- ▶ bottom of tank excavation
- ▶ boreholes drilled below bottom of AST
- ▶ along associated piping at line depth and intervals representative of the full length and area covered

### **APPROVED TEST METHODS**

- ▶ EPA analytical methods
- ▶ Department approved (table on page 2 of this factsheet)

### **ALTERNATIVE TO SOIL SAMPLING**

The Department may consider an alternative to the soil sampling requirement for closure if the AST operator can demonstrate that there is no evidence of past or present contamination at the facility. Operators may demonstrate that this requirement is met by providing records from an approved monthly leak detection method conducted for the previous 12 months.

Operators seeking the alternative to the soil sampling requirement shall:

- ▶ provide records of monthly leak detection monitoring for past 12 months
- ▶ demonstrate that the facility or AST has operated an approved leak detection system

### **DOCUMENTATION**

Submit completed DEQ Registration for Aboveground Storage Tank Form (Form 7540-AST) with attached copies of the following:

- ▶ permit from the local building official
- ▶ laboratory test results
- ▶ a description of the area sampled
- ▶ site map (indicate closed AST and piping)
- ▶ photographs of site (indicate sampled areas if applicable)

### **SUBMIT DOCUMENTATION TO**

Virginia Department of Environmental Quality  
P.O. Box 10009, Richmond, Va. 23240-0009

### **RECORDKEEPING**

Operators shall

- ▶ maintain all records relating to compliance with regulations for a period of five years
- ▶ make these records available to the Department at any time upon request

When deemed necessary by the Department, the operator of an AST permanently closed prior to June 24, 1998, shall assess the site and close the AST in accordance with the requirements of 9 VAC 25-91-10 et seq.

### **DEQ REGIONAL OFFICE PHONE NUMBERS**

Northern Virginia Regional Office	(Woodbridge)	(703) 583-3800
Valley Regional Office	(Harrisonburg)	(540) 574-7800
Piedmont Regional Office	(Richmond)	(804) 527-5020
West Central Regional Office	(Roanoke)	(540) 562-6700
Southwest Regional Office	(Abingdon)	(540) 676-4800
Tidewater Regional Office	(Virginia Beach)	(757) 518-2000
South Central Regional Office	(Lynchburg)	(804) 582-5120

DEQ Central Office	Richmond	(804) 698-4317
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## Fact Sheet: AST Closure Site Assessment

Acceptable TPH Analytical Methods for Use During AST Closure		
Fuels	TPH Analytical Methods	Applicable Medium <sup>1</sup>
Gasoline and JP-4	California LUFT Method Wisconsin DNR - GRO SW 846 8015b (modified TPH - GRO)	w & s w & s w & s
Diesel, Fuel Oil #1 and #2, Jet Fuel <sup>2</sup> , Kerosene	California LUFT Method Wisconsin DNR - DRO SW 846 8015b (modified TPH - DRO)	w & s w & s w & s
Crude Oil, Fuel Oil #4, #5, and #6, Used Oil, Hydraulic Oil	EPA 413.1 EPA 413.2 EPA 418.1 Wisconsin TRPH	w s w & s s
<sup>1</sup> Applicable medium refers to the sample matrix that may be analyzed by the subject test method. "w" refers to an analytical method that may be used to analyze water "s" refers to an analytical method that may be used to analyze soil  <sup>2</sup> JP-4 is a wide-cut fuel made by blending gasoline and kerosene fractions in a 65 to 35 ratio.  References: EPA 100 – 400 Series – Methods for Chemical Analysis of Water and Wastes, EPA – 600/4-79-020, March 1983 EPA SW-846 – Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Revision 5, April 1998 Publ. – SW - 140. Modified GRO, Method for Determining Gasoline Range Organics, Wisconsin DNR, September 1995. Publ. – SW – 141. Modified DRO, Method for Determining Diesel Range Organics, Wisconsin DNR, September 1995. Publ. – SW – 143. Wisconsin DNR, 1992		

# Virginia Department Of Environmental Quality (DEQ) Storage Tank Program

## Fact Sheet: AST Permanent Closure

### PERMIT

The AST operator must obtain a permit from the local building official or designee

### REGISTRATION

ASTs must be registered with DEQ prior to closure and a registration fee must be paid. Registration renewal is not required if the tank has been registered or the registration has been renewed (including the payment of registration fees) within five years prior to closure.

### INSPECTION

An inspection must be conducted by the building official or designee as per the Uniform Statewide Building Code or by DEQ

### CLOSURE

- ▶ Closure of AST(s), including AST(s) operated by the Federal Government, must be approved by the building official (Dept. of General Services or designee functions as building official if the AST is operated by the Commonwealth)
- ▶ AST removal from the property and site restoration is required under code (unless the building official or designee determines it is not necessary)
- ▶ Remove all liquid and sludge from the AST and connecting lines
- ▶ Any waste products removed must be disposed of in accordance with all applicable state and federal requirements
- ▶ Tank(s) must be rendered vapor-free (provisions must be made for natural tank breathing to ensure that the tank remains vapor free)
- ▶ Vent lines remain open and maintained in accordance with codes  
(For further information see, API 2015, Cleaning Petroleum Storage Tanks; API 2015A, A Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning; and API 2015B, Cleaning Open Top and Covered Floating Roof Tanks)
- ▶ Disconnect piping at all tank openings and securely cap or plug all lines such as
  - < fill line                      < gauge opening
  - < pump suction                < vapor return
- ▶ Access openings for inspections (manways) must be securely fastened in place (spacers are normally put between the tank and cover to assist ventilation)
- ▶ Secure AST(s) and piping against tampering
- ▶ Safeguard AST(s) against floatation caused by flooding
- ▶ Stencil permanently closed and the date of closure on the AST (i.e. PERMANENTLY CLOSED Date) and the name of the product last stored in the tank
- ▶ Record tank size, location, date of closure and method used for placing the closed tank in a safe condition and retain in facility records for 5 years.

### SITE ASSESSMENT

- ▶ Complete site assessment prior to submitting DEQ form 7540 AST for closure
- ▶ Samples are required in any area where contamination is likely to have occurred

### NOTIFICATION

- ▶ Report to DEQ and the local building official or designee immediately if closure is in response to containment and cleanup actions
- ▶ Notify DEQ at least 14 days prior to the commencement of closure operations
- ▶ Report evidence of a discharge of oil to DEQ immediately upon learning of a discharge. Evidence includes stained soil, free product, and petroleum vapors. The AST operator must, upon receipt of the following analytical results from samples collected during closure, report a discharge to DEQ:
  1. TPH concentration in any soil sample that is greater than or equal to 100 mg/kg
  2. TPH concentration in any water sample that is greater than or equal to 1 mg/l
  3. Any other petroleum constituent that exceeds the detection limit for that constituent
- ▶ Notify DEQ within 30 days after permanent closure by submitting DEQ Form 7540-AST along with the following:

" Laboratory Results	" A description of the Area Sampled
" A photograph of the site including the area sampled	" Site Map

Submit to:

Virginia Department of Environmental Quality  
P.O. Box 10009, Richmond, Va. 23240-0009

**All AST(s) are considered to be in service until they are permanently removed or properly abandoned. This means that until permanent closure, tanks are subject to all of the registration, inspection, response planning and reporting requirements.**

(Revised 4/23/01)

# **Virginia Department of Environmental Quality Storage Tank Program**

## **Fact Sheet: Reporting Requirements for Suspected or Confirmed Releases from Regulated USTs, Unregulated USTs, and ASTs.**

The owner or operator of a storage tank must report a release to DEQ when:

**1. Contaminants are released into and/or observed in the environment. Evidence includes:**

- ▶ There is a spill or release from the storage tank system
- ▶ There is an impacted receptor
- ▶ Drinking water supplies are contaminated
- ▶ Vapors are observed in a buildings or structures
- ▶ Free product is observed in the environment or in monitoring wells used for release detection
- ▶ Stained soil is observed
- ▶ A sheen is observed on surface water

Exceptions:

- ▶ A discharge of oil from a facility (ASTs, unregulated USTs, or other types of facilities) does not have to be reported to DEQ if it is less than 25 gallons, does not reach state waters, is cleaned up immediately and the facility retains records of the incident as required by Article 11.
- ▶ A spill or overfill from a regulated UST system does not have to be reported to DEQ if the spill is less than 25 gallons, is cleaned up within 24 hours and does not cause a sheen on surface waters.

**2. The product dispensing equipment is operating in an unusual manner (Suspected Release). Examples are:**

- ▶ Loss of product
- ▶ Water in the tank
- ▶ Product dispensing equipment does not dispense product or dispenses product at a greatly reduced rate
- ▶ An alarm is issued by an automatic line leak detector

**3. Monitoring results from a release detection method indicate that a release may have occurred (Suspected Release). Examples are:**

- ▶ Vapors are observed in vapor monitoring wells
- ▶ Inventory control discrepancies indicate that a release may have occurred (a gain or loss of product >130 gallons + 1% of throughput)
- ▶ Alarms from automatic tank gages, interstitial monitors, sumps, etc. indicate that a release may have occurred
- ▶ Statistical inventory reconciliation (SIR) indicates a release:  
Inconclusive SIR results for two consecutive months or three inconclusive SIR results within a 6 month period must be reported

**4. Conditions 1 - 3 above are not observed and analytical results for any sample collected at the site are as follows:**

- ▶ Analytical results from samples collected during storage tank closure:  
Regulated USTs, ASTs, or Unregulated USTs that contain petroleum:
  1. TPH - soil greater than or equal to 100 mg/kg
  - TPH - water greater than or equal to 1 mg/l
  2. All other petroleum constituents greater than the detection limit for the constituent

Regulated USTs containing non-petroleum regulated substances:

Analytical results for a regulated substance that are greater than the detection limit for that substance.

- ▶ Analytical results from samples collected at any time other than storage tank closure:  
Any concentration of petroleum or regulated substance that is above the detection limit for that substance.

**Fact Sheet:      Reporting Requirements for Suspected or Confirmed Releases from Regulated USTs, Unregulated USTs, and ASTs.**

**DEQ Regional Office Phone Numbers:**

Tidewater Regional Office (VA. Beach)	(757) 518-2000
Northern VA. Regional Office (Woodbridge)	(703) 583-3800
Piedmont Regional Office (Richmond)	(804) 527-5020
Valley Regional Office(Harrisonburg)	(540) 574-7800
West Central Regional Office (Roanoke)	(540) 562-6700
Southwest Regional Office (Abingdon)	(540) 676-4800
South Central Regional Office (Lynchburg)	(804) 582-5120

# **Virginia Department of Environmental Quality Storage Tank Program**

## **Fact Sheet: Elements of an Initial Abatement Report**

An Initial Abatement Report should contain or address the following:

1. Title Page
  - ▶ site name
  - ▶ site address
  - ▶ pollution complaint number
  - ▶ date
  - ▶ DEQ case manager
2. Signature Page
  - ▶ preparer's name, address, telephone and fax number
  - ▶ professional certification information (if applicable)
  - ▶ Tank owner/operator name, address, telephone and fax number
2. General Site Information
  - ▶ site description
  - ▶ updated site map to include:
    - soil sample locations (if applicable)
    - monitoring well locations (if applicable)
  - ▶ storage tank information
    - type(s)
    - size(s)
    - age(s)
    - status (closed vs. active)
3. Release Information
  - ▶ source description (cause of release)
  - ▶ type of product released
  - ▶ amount of product released (please explain how this estimate was derived)
  - ▶ release history (when, where, duration)
  - ▶ sampling data
4. Initial Abatement Measures Taken
  - ▶ actions taken to prevent further release
  - ▶ hazard mitigation
  - ▶ free product check and/or recovery
  - ▶ actions taken to prevent further migration of contaminants
  - ▶ soil management (if applicable)
5. Additional Documentation
  - ▶ certificate(s) of disposal
  - ▶ certificate(s) of analyses
  - ▶ applicable photographs
6. Activity Authorization Forms for the Initial Abatement Phase. Please note that AAFs should be included with the report, however, they should not be bound within the report.

# **Virginia Department of Environmental Quality Storage Tank Program**

## **Fact Sheet: Elements of a Corrective Action Plan**

A Corrective Action Plan should contain or address the following:

1. Title Page
  - ▶ site name
  - ▶ site address
  - ▶ pollution complaint number
  - ▶ date
  - ▶ DEQ case manager
2. Signature Page
  - ▶ preparer's name, address, telephone and fax number
  - ▶ professional certification information (if applicable)
  - ▶ Tank owner/operator name, address, telephone and fax number
3. Description of Corrective Actions Conducted under Interim Authorization
4. Description of Proposed Corrective Actions
  - ▶ narrative description
  - ▶ sketches/plans
  - ▶ design calculations
  - ▶ map(s) showing locations of planned remedial actions and major system components (e.g. monitoring and recovery wells, system housing, effluent discharge, etc.)
  - ▶ description of proposed operational schedule
5. Remedial Endpoints
  - ▶ list of numerical endpoints for all phases of contamination
    - free phase
    - dissolved phase
    - residual phase
    - vapor phase
    - system effluent
  - ▶ justification for each endpoint (how was each endpoint derived?)
6. Operational and Post Operational Monitoring Schedules
  - ▶ parameters
  - ▶ frequency
  - ▶ locations
  - ▶ media
  - ▶ methods
7. Proposed System Shutdown Schedule

## **Fact Sheet: Elements of a Corrective Action Plan**

8. Reporting Schedule
  - ▶ periodic monitoring
  - ▶ annual reports
  - ▶ emergency reports
  - ▶ free product removal reports
9. Description of Contaminated Material Generated by the Proposed Corrective Action (if applicable and method(s) proposed to treat/dispose that material)
10. Proposed Actions to Notify Persons Affected by the Release and/or Corrective Actions (public notice)
11. Permitting Requirements
  - ▶ what permits are required before the proposed corrective actions may be implemented?
  - ▶ what actions are necessary to obtain the required permits?
12. Projected Costs to Achieve Remedial Endpoints
13. Estimated Length of Time to Achieve Endpoints (discuss methodology used to derive this estimate and show calculations)
14. Activity Authorization forms for the Corrective Action Plan Development Phase. (AAFs should be included with the report, however, they should not be bound within the report)

# **Virginia Department of Environmental Quality Storage Tank Program**

## **Fact Sheet: Elements of a Free Product Removal Report**

A Free Product Removal Report should contain or address the following:

1. Title Page
  - ▶ site name
  - ▶ site address
  - ▶ pollution complaint number
  - ▶ date
  - ▶ DEQ case manager
2. Signature Page
  - ▶ preparer's name, address, telephone and fax number
  - ▶ professional certification information (if applicable)
  - ▶ Tank owner/operator name, address, telephone and fax number
3. Characterization of Free Product
  - ▶ in wells
    - quantity
    - type
    - thickness
  - ▶ in excavation(s)
    - quantity
    - type
    - thickness
  - ▶ other
    - quantity
    - type
    - thickness
4. Method of Free Product Recovery
  - ▶ type and description of system
  - ▶ how method used prevents free product migration
  - ▶ amount of free product recovered
  - ▶ disposition of recovered free product
5. Disposition of Other Wastes Generated as a Result of Free Product Recovery
  - ▶ type of waste
  - ▶ amount
  - ▶ contaminant concentrations in waste stream(s)
  - ▶ description of method used to treat or dispose waste(s) (include information on where waste is treated/disposed)
6. Free Product Recovery Data
  - ▶ Table of recovered amounts
  - ▶ Graph(s) indicating cumulative recovery as a function of time

(Revised 2/10/98)



# **Virginia Department of Environmental Quality Storage Tank Program**

## **Fact Sheet: Elements of a Site Characterization Report**

A Site Characterization Report should address or contain the following:

1. Title Page
  - ▶ Site name
  - ▶ Site address
  - ▶ PC number
  - ▶ Date
  - ▶ DEQ Case Manager
2. Signature Page
  - ▶ Preparer's name, address, telephone and fax numbers
  - ▶ Professional certification information (if applicable)
3. Site Assessment
  - ▶ Site, facility, and release description (including source, type and quantity)
  - ▶ Topographic map (showing site location)
  - ▶ A complete site map
    - including scale, north arrow, and legend
    - including all buildings and roads (labeled)
    - clearly showing the entire UST system (pipelines, pump island(s), etc.)
    - showing soil or water sample locations and depths
    - showing other important features (such as monitoring wells, drinking water wells, streams, etc.)
  - ▶ Tank data, if applicable (number of tanks, size, age, contents, status) for all tanks on site
  - ▶ Site specific geologic information (including soil descriptions)
  - ▶ Hydrologic information (including surface water and ground water)
  - ▶ Complete delineation of all four phases of contamination (vertically and horizontally)
    - free product
    - adsorbed or residual phase
    - dissolved phase
    - vapor phase
  - ▶ provide all boring logs, well logs, well construction diagrams, and isoconcentration maps (for each phase of contamination)
4. Risk Assessment
  - ▶ Description of on-site and off-site receptors including:
    - existing human and biological receptors
    - potential human and biological receptors (based on fate and transport mechanisms)
    - all potable water wells which have been or may be impacted
    - all surface waters and nonpotable wells
    - basements and other subsurface structures (i.e. utilities)
  - ▶ Discussion of site specific means of exposure (ingestion, inhalation, dermal contact) and remediation requirements (if applicable)
  - ▶ Risk based endpoints

## **Fact Sheet: Elements of a Site Characterization Report**

5. Remediation Assessment
  - ▶ Evaluation of appropriate remedial options (if necessary) including:
    - site specific conditions
    - achievable risk based endpoints
    - estimated time to achieve endpoints
    - estimated costs
    - current/future beneficial results
  - ▶ Final recommendation and rationale for selection
6. Activity Authorization Forms for the Site Characterization Phase (AAFs should be included with the report, however, they should not be bound within the report)

# **Virginia Department of Environmental Quality Storage Tank Program**

## **Fact Sheet: Monitoring Well Abandonment**

Monitoring wells must be properly abandoned after they have served their intended purpose. The abandonment of monitoring wells which were installed for investigations required under Articles 9 and 11 of State Water Control Law will be administered by staff in the DEQ Regional Offices. Responsible Persons (RP) abandoning monitoring wells as part of the SITE CLOSURE PHASE may be eligible for reimbursement of all or part of the cost of the abandonment if those activities are pre-approved by the DEQ Regional Office.

### **General Requirements**

No permits will be necessary for monitoring wells unless they were previously permitted by the Virginia Department of Health.

The Regional Case Manager should be contacted prior to abandonment and the method of abandonment (tremie grouting, over drilling, etc.) should be approved by the Case Manager on the AAF.

If the RP is seeking reimbursement of costs associated with abandoning monitoring wells, an Activity Authorization Package must be submitted to the Regional Case Manager and approved prior to well abandonment.

After monitoring wells are abandoned, a Site Closure Report that describes well abandonment procedures and addresses other site closure issues identified by the Case Manager should be submitted to the Regional Office.

### **General Abandonment Procedures**

The well construction, depth to water table and hydrologic conditions should be reviewed.

If the monitoring well is a water table aquifer well (does not penetrate a confined aquifer) then the primary purpose of the abandonment will be to prevent surface contamination from reaching the groundwater.

If the monitoring well penetrates a confined (deep) aquifer, the primary purpose of the abandonment will be to restore, as far as possible, the original hydrogeologic conditions, and detailed site specific abandonment procedures will need to be developed.

The majority of monitoring wells are in water table aquifers, are 2-6 inches in diameter and are less than 50 feet deep. The following general abandonment procedures may be followed for those monitoring wells.

The surface completion components (vault, manholes, risers, etc.) should be removed.

The well casing should be cut off below grade at an elevation that is unlikely to be exposed at the surface in the future.

The well casing should be filled with a fluid bentonite grout mixture (1-12 lbs. bentonite/1 gallon water) using a tremie pipe and a permanent cap placed over the well casing.

The excavation created by the removal of well surface components should be filled to grade with materials that are compatible with the surrounding area. The surface of this excavated area should then be restored to conform with the surrounding surface.

# **Virginia Department of Environmental Quality (DEQ) Storage Tank Program**

## **Fact Sheet: Managing Used Oil - Commercial Facilities**

### **Regulations Applicable to Used Oil Storage Tanks:**

USTs - Used oil is a regulated substance and USTs containing used oil are subject to the requirements of the UST Technical Regulation. Used oil USTs containing listed hazardous wastes or used oil that exhibits one or more hazardous characteristics are subject to the requirements of the Virginia Hazardous Waste Management Regulations (VHWMR).

ASTs - Individual used oil ASTs having a capacity of greater than 660 gallons are subject to the Facility and Aboveground Storage Tank Registration requirements (9 VAC 25-130-10) and the closure requirements of the Aboveground Storage Tanks Pollution Prevention regulation (9 VAC 25-140-10). ASTs containing listed hazardous wastes or used oil that exhibits one or more hazardous characteristics are subject to the requirements of the VHWMR.

Releases of used oil from Storage Tanks must be reported to the DEQ Storage Tank Program.

### **Reimbursement from VPSTF:**

USTs - Costs incurred for cleaning up releases of used oil reported after December 22, 1989, are eligible for reimbursement.

ASTs - Costs incurred for cleaning up used oil discharges are not eligible for reimbursement. Fund access for discharges from ASTs is limited to those petroleum products on which a Fund fee is charged (see Article 10 of State Water Control Law; Sections 62.1-44.34:11.2.C and 62.1-44.34:13).

### **Used Oil Characterization:**

- Used oil mixed with a listed hazardous waste must be managed as a hazardous waste. This material is considered a hazardous waste fuel if it is burned for energy recovery (see Part XIII of the VHWMR).
- Used oil mixed with a characteristic hazardous waste is a hazardous waste if the mixture exhibits a hazardous characteristic. There are some exceptions for ignitability; see Part XIII of the VHWMR.
- If the concentration of halogens in used oil exceeds 1000 ppm, the oil is presumed to be a hazardous waste. This presumption may be rebuttable by any of the following:
  - the elevated halogen concentration is from CFCs in refrigeration compressor oil (excluded from regulation as a hazardous waste; VHWMR 9 VAC 20-60-110.B.11)
  - the used oil is a high temperature chlorinated cutting oil
  - there is saltwater in the oil (this may give false high positives)
  - analyses indicate that the oil does not contain halogenated hazardous constituents that are listed in Appendix 3.6 of the VHWMR.
- Used oil that is not a hazardous waste (i.e. contains neither listed hazardous wastes nor exhibits hazardous characteristics) and will be disposed rather than recycled is a solid waste.
- For additional information on used oil characterization, please contact the DEQ Hazardous Waste Program.

## Fact Sheet: Managing Used Oil - Commercial Facilities

### Used Oil to be Burned for Energy Recovery

#### A. Off Specification Used Oil

- Used oil exceeding any of the following levels is termed "off-specification used oil fuel".

arsenic	5 ppm total
cadmium	2 ppm
chromium	10 ppm
lead	100 ppm
flash point	≤100 °F
total halogens	4,000 ppm
- Off specification oil may only be managed by marketers or burners who have notified DEQ of this activity and have obtained an EPA ID number (see Part XIII of the VHWMR).
- Persons transporting off specification used oil must have an EPA ID number.
- Off specification oil may only be burned in industrial furnaces or boilers. The entity generating the oil may also burn this oil on site in an oil-fired space heater (no oil from offsite allowed unless it is from a household). Certain standards for the heaters apply. Please see Part XIII of the VHWMR for more information.
- Entities generating off specification used oil should offer it only to marketers or burners who have notified DEQ that they manage off specification oil and who have an EPA ID number.

#### B. On Specification Used Oil

- Does not exceed specification limits listed above, has not had a hazardous waste added to it, or is from households.
- Subject only to the analysis and record keeping requirements under Part XIII of the VHWMR.
- May be managed or burned by anyone. There are no generator requirements other than analysis.

#### Used Oil Filters:

- A final rule on used oil filters was promulgated in the May 20, 1992, Federal Register.
- Used oil filters are not regulated as a hazardous waste if they are managed by one of the following methods:
  - puncturing the filter anti-drain back valve or the filter dome end and hot-draining
  - hot-draining and crushing
  - dismantling and hot-draining; or
  - any other equivalent hot-draining method that will remove used oil
- Filters managed by one of the above methods are still regulated as a solid waste.
- If filters have not been managed by one of the methods listed above, they contain oil, and are to be disposed, then the generator must use TCLP to determine if they are a hazardous waste.
- Oil filters from households (i.e. persons who change oil in their own cars) are exempt from the VHWMR.

#### DEQ Offices and Telephone Numbers:

Northern Virginia Regional Office	703-583-3800
Piedmont Regional Office	804-527-5020
Tidewater Regional Office	757-518-2000
Valley Regional Office	540-574-7800
West Central Regional Office	540-562-6700
Southwest Regional Office	540-676-4899
South Central Regional Office	804-582-5120
Central Office	804-698-4000

# **Virginia Department of Environmental Quality (DEQ) Storage Tank Program**

## **Fact Sheet: Managing Used Oil - Homeowners**

Used oil contains chemical compounds that can be harmful to humans and other animals. When managed properly, however, used oil may again be of beneficial use. Used oil may be blended and recycled as a heating or industrial fuel and also may be re-refined and made into new lubricants. Persons who change the motor oil in their own vehicles are responsible for managing the used oil in a manner that is protective of human health and the environment.

### **Persons who change the oil in their own vehicles should:**

1. Collect and store that oil in water tight containers.
2. Take used oil to the solid waste collection center for your county or city. Contact the local Public Works office to obtain information about the solid waste collection center nearest to your residence. Used oil may also be collected by commercial recycling facilities and local businesses (e.g. local gas stations, some auto parts stores).
3. Store and dispose used oil filters in a manner that prevents oil discharges. It is recommended that you:
  - a. drain as much oil from the filter as possible;
  - b. place the oil filter in a plastic bag; and
  - c. dispose of the used oil filter at your local solid waste collection center (i.e. landfill/transfer station) or place with other household waste to be collected by your local waste collection agency.

### **Do not:**

1. Mix used oil with other fluids such as water, antifreeze, degreasers, gasoline or other motor fuels, etc. Mixing used oil with other fluids makes that oil more difficult to recycle and re-use.
2. Dispose of oil by placing that oil into or on driveways, ditches, dry wells, surface water, roadways (for dust control), storm sewers, etc. The discharge of oil into or upon state lands, waters, or storm sewers is a violation of Article 11 of Virginia Water Control Law. Persons discharging oil in this manner may be fined and/or required to clean up that discharge.

(Revised 3-30-98)

## In Summary:

There are approximately 400,000 aboveground and underground home heating oil tanks in Virginia. Commonly, homeowners and home purchasers ask what must be done with an old oil tank. Owners who wish to preclude future problems or liabilities associated with the tank should "close" the tank structure in accordance with the Uniform Statewide Building Code. This involves obtaining a building permit from the local code official, and proceeding to close the tank in place or removing it from the ground. In-place closure involves emptying the tank and filling it with an inert solid material like sand, gravel, or cement slurry. Removal involves emptying the tank, mitigating any fire hazards, and safely removing the tank for recycling or disposal.

It is recommended that you review and use the included handy checklist entitled "**Homeowner's Monthly Tank Checklist**". A "**List of Consultants**" is available from any DEQ Regional Office as well as our web page [www.deq.state.va.us/tanks](http://www.deq.state.va.us/tanks).

For further information, please contact the DEQ Central Office, at (804) 698-4000 or the DEQ's Regional Office nearest you:

**Southwest Region**  
355 Deadmore St.  
P.O. Box 1688  
Abingdon, VA 24212  
(540) 676-4800

**West Central Region**  
3019 Peters Creek Rd.  
Roanoke, VA 24019  
(540) 562-6700

**Piedmont Region**  
4949-A Cox Road  
Glen Allen, VA 23060  
(804) 527-5020

**Valley Region**  
4411 Early Road  
Harrisonburg, VA 22801  
(540) 574-7800

**Northern Region**  
13901 Crown Court  
Woodbridge, VA 22193  
(703) 583-3800

**Tidewater Region**  
5636 Southern Blvd.  
Virginia Beach, VA 23462  
(757) 518-2000

**South Central Region**  
7705 Timberlake Rd.  
Lynchburg, VA. 24502  
(804) 582-5120

### Homeowner's Monthly Tank Checklist

- \_\_\_ Check fuel use (an increase may indicate a tank or line leak). Watch deliveries to prevent spills/overfills. Keep track of your oil consumption (note any sudden, unexplained change).
- \_\_\_ Check for water in the tank (record measurement, if taken).
- \_\_\_ Check oil/water separator (if present), newer models are metal, older are glass (which can shatter during freezing temperatures), drain if needed. If you are unsure, talk to your heating professional.
- \_\_\_ Look for unexplained dead or withered vegetation in area.
- \_\_\_ Make sure the vent line clear.
- \_\_\_ Make sure the fill gauge (if one is installed) is functioning.
- \_\_\_ Check the overfill whistle (if one is installed).
- \_\_\_ Check for signs of spills or overfills around the fill pipe or vent lines
- \_\_\_ Any problems with the operation of the furnace?
- \_\_\_ Check the fill cap (if damaged/missing, replace immediately, oil can overflow if too much water enters tank.)
- \_\_\_ If tank is aboveground, check the entire tank surface (rust, dents, etc.) for damage.
- \_\_\_ If tank is aboveground, check tank support (is it sturdy/solid?).
- \_\_\_ Check all pipeline connections and bungs (if visible).
- \_\_\_ Are there any petroleum vapors in basement/crawlspace? (If vapors are present, call DEQ.)
- \_\_\_ Check sump pump or floor drain (if present), for petroleum odors or other signs of petroleum. Call DEQ immediately if oil or vapors are detected.
- \_\_\_ Look for any signs of oil (odors, sheens on water surfaces, visible puddles of oil, etc.) on property. If oil is found, notify DEQ immediately.

My Heating Repair Professional (Name & Number): \_\_\_\_\_

My Oil Distributor (Name & Number): \_\_\_\_\_

#### Please Remember:

Report petroleum odors, petroleum sheens on water surfaces, or suspected problems to DEQ.

Do not attempt to repair a tank system yourself.

# Home Heating Oil

## ABOVEGROUND & UNDERGROUND STORAGE TANKS

### A FACT SHEET

## Home Heating Oil Tank:

Definition - A home heating oil tank (aboveground or underground) stores heating oil for consumption on the premises where stored.

## Responsibilities of a Tank Owner/Operator:

Look at your tank system. A monthly check is recommended as a preventive maintenance tool. Report sudden changes in product level or problems to a heating repair professional or your oil supplier.

Understand your tank system and how it works. You should know the tank size, age, construction material (of both tank and piping) and who to call if a repair is needed. Keep track of all deliveries.

If obvious signs of contamination are found (such as petroleum vapors, oil on property, etc.), **immediately report petroleum releases or discharges to any DEQ Regional Office listed under the Summary section of this brochure.**

Virginia Department of Environmental Quality  
<http://www.deq.state.va.us/tanks>  
Office of Spill Response and Remediation







## General Home Heating Oil Tank Information:

1) Any unexplained presence of water in the tank may signify a leak. There is a water-finding paste available to check for water in your tank. Some aboveground tanks have a small oil/water separator installed (a small bowl-like fixture at the bottom of the tank) to drain water from the tank. A small amount of water is often in a tank (condensation), but a sudden increase should be reported to your oil supplier. If water needs to be pumped out of a tank, be sure that the contents are properly collected, contained, and disposed, **not pumped onto the ground.**

2) Operating problems with a furnace may also signify a leak. Have a heating repair professional inspect your heating system on a regular basis. Sudden changes in oil consumption or the furnace shutting off may indicate a leak or other problem.

3) **Do not wait for your tank to leak to inspect, protect, or replace it.** Since you cannot see the condition of underground tanks, you are usually not aware of developing problems. Underground tanks are especially susceptible to problems because of their corrosive environment. The rate of corrosion varies due to a number of site conditions and type of tank construction.

4) **Tanks and lines installed aboveground allow the owner to be able to see problems quickly while they are still "small", however, it is recommended that the line be protected from accidental damage. Underground tanks and piping require more diligent professional attention.**

5) Usually, the small 275 gallon aboveground tanks should be placed inside or in a sheltered area. These tanks were often specifically designed to be used inside (shaped to be able to fit through doorways) and the steel construction was not intended for outside use. They corrode at an accelerated rate and may topple over due to severe weather conditions.

6) Aboveground tanks should be placed horizontally (with sturdy supports) on a concrete pad. You can also surround the pad with a row of mortared cinder blocks so that if any oil leaks from your tank, it will be temporarily contained for an easier cleanup.

7) Tank piping is a common source of contamination. Piping can be encased so that if a leak occurs it is contained inside another pipe. A stop cock or valve also may be placed at the bottom of the tank to prevent a line leak from draining the tank when the tank is not used.

8) Proper installation and maintenance of the tank system is the key to protecting your property from oil contamination. Use professional tank installers and/or repair technicians to work on your tank system.

9) DEQ recommends that unused underground home heating oil tanks and associated piping be removed from the ground and properly disposed. If this is not possible, the tank should be emptied, cleaned, and then filled with inert material (sand, cement slurry) to prevent future problems (collapse). Fill pipes should be sealed or removed. Tank closure work should be conducted by a professional. Follow local codes and ordinances. Report any signs of contamination/leakage to DEQ.

10) DEQ has a reimbursement fund, called the Virginia Petroleum Storage Tank Fund (VPSTF), from which a **homeowner may be able to recover some of the costs of cleanups associated with leaking tanks. VPSTF does not reimburse tank removal, repair, or replacement costs,** only eligible cleanup costs. The financial responsibility requirement for home heating oil tanks is \$500 per occurrence. The actual amount reimbursed depends on following DEQ's directions and preapproval for conducting the cleanup and whether the costs you incur are within the usual, customary rates reimbursed by DEQ. Copies of applicable homeowner insurance documents must be provided to DEQ and may affect access to VPSTF.

**NOTE:** The first \$10,000 in approved costs above the financial responsibility level will be deferred until VPSTF funds become available.

## Commonly Asked Questions/Answers:

### **What regulations apply to my home heating oil tank?**

The Uniform Statewide Building and Statewide Fire Prevention Codes have requirements related to the installation, repair, and closure of home heating oil tanks. All underground home heating oil tanks are exempt from the State and Federal Underground Storage Tank (UST) Technical Regulations. Aboveground home heating oil tanks having a capacity of 5,000 gallons or less are exempt from DEQ's Pollution Prevention requirements. Discharges of oil are prohibited by Article 11 of State Water Control Law. Always check local codes and ordinances to see if any apply.

### **What do I do with a home heating oil tank that is no longer being used?**

Check with your local code officials. The building code may require the removal of unused tanks. The DEQ recommends that unused heating oil tanks be removed. Potential buyers are sometimes reluctant to purchase property with abandoned or improperly closed home heating oil tanks; therefore, closure may prove beneficial. Removal also eliminates a potential threat to the environment.

### **If I choose to remove my home heating oil tank, what are the requirements?**

You must obtain a local building permit and any inspections as required by your local building official to remove or close the tank. You do not need to contact the DEQ **unless** you discover signs of a leak, spill, or contamination.

### **What do I do if I discover evidence of a leak?**

You must immediately report evidence of a leak or spill (for example: stains on the soil, strong petroleum odors, puddles of oil, etc.) to your local DEQ Regional Office. Please refer to the end of this brochure for the addresses and telephone numbers of the DEQ Regional Offices. DEQ staff will provide you with the appropriate procedures to follow. Work performed more than 24 hours prior to reporting a leak to DEQ or a local official is not eligible for reimbursement.

**What kind of companies do this sort of work?** Often, you can find them in the telephone yellow pages under "Environmental Consultants". When choosing a firm get several estimates and references.

(Fact Sheet Revision Date:7/3/01)



## **APPENDIX D**

### **Release Report Form**

## PC Number \_\_\_\_\_

(Revised 1/8/99)

## **APPENDIX E**

### **DEQ Storage Tank Program Letter Requirements and Example Letters**

## Appendix E

### Storage Tank Program: Letter Requirements and Example Letters

Listed below are minimum content requirements for and examples of many of the letters that staff must write in petroleum storage tank program. The example letters are provided for staff convenience, however, staff should feel free to modify these letters as needed provided that the specified requirements for individual letters are met.

Table E-1. DEQ Storage Tank Program Example Letters and Letter Requirements	
Title	Date of Latest Revision
Requirements for Suspected Release Letters	2-7-01
Example Letter: Suspected Release from Petroleum Storage Tank(s)	2-7-01
Requirements for Confirmed Release Letters	2-7-01
Example Letter: Confirmed Release from Petroleum Storage Tank(s)	2-7-01
Example Letter: Discharge of Oil from a Small Heating Oil Tank. Category 1 Sites	4-17-01
Example Letter: Discharge of Oil from a Small Heating Oil Tank. Category 2 Sites	4-17-01
Example Letter: Discharge of Oil from a Small Heating Oil Tank. Category 3 Sites	4-17-01
Requirements for Small Heating Oil Tank Discharge Letters	4-17-01
Example Letter: Petroleum Storage Tank Amended Notification Form for Permanent Tank Closure(s)	2-7-01
Example Letter: Case Closure After Completion of the SCR	2-7-01
Example Letter: Case Closure After Completion of Corrective Actions	2-7-01
Example Letter: Case Closure of Home Heating Oil Tank Discharge	3-15-01
Requirements for Case Closure Letters	3-15-01

Table E-1 Continued. DEQ Storage Tank Program Example Letters and Letter Requirements	
Title	Date of Latest Revision
Example Letter: Interim Authorization to Initiate Corrective Action	2-7-01
Requirements for Interim Authorization Letters	2-7-01
Example Letter: Request for Corrective Action Plan	2-7-01
Example Letter: Letter Directing RP to Request Coverage under the General VPDES Permit for Petroleum Contaminated Sites	2-2-99
Example Letter: Transmittal Letter for Petroleum Discharge General Permit	2-2-99
Requirements for Transmittal Letter, Petroleum Discharge General Permit	12-1-00
Example Letter: Termination of Coverage Under the General VPDES Permit for Petroleum Contaminated Sites	2-2-99
Letter Requirements for Termination of Coverage Under the General VPDES Permit for Petroleum Contaminated Sites	12-1-00

### **Requirements for Suspected Release Letters**

- Identify PC#,
- Date of RP suspected release notification,
- Identify recipient as RP,
- Reference State Law,
- Include the language: "...the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 23 and 9 VAC 25-580-10 et seq."
- List deadlines for performing tightness test and/or site check and submitting Release Investigation Report. Deadlines for performing the tightness test and/or site check should be within 7 days after suspecting the release or another reasonable period as specified by the Case Manager.
- Notify RP that Activity Authorization Form required for reimbursement,
- Notify RP that certain emergency actions do not require prior authorization,
- Notify RP that activities performed 24 hours prior to the report date are ineligible for reimbursement,
- Include Attachments:
  - Activity Authorization Form
  - Program Fact Sheets.

(Revised 2/7/01)



Example Letter:  
Suspected Release from Petroleum Storage Tank(s)

Date

Addressee

re: Site Name/Location:  
Facility and Tank Identification:  
DEQ Tracking Number: PC#

Dear :

Thank you for notifying the Department of Environmental Quality (DEQ) on **[date]** of a suspected petroleum release at the referenced site. Based on the evidence available to us, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 23 and 9 VAC 25-580-10 et seq. has determined that you are the Responsible Person (RP) for this potential petroleum release. This means that you are responsible for release confirmation and for performing certain activities associated with this release as required by State Water Control Law (Articles 9, 10, and 11 of the Virginia Code, Section 62.1-44.34:8 through :23, inclusive). Your responsibilities include **[list all applicable]**:

(1) conducting a "system tightness" test if the system is still in place to determine tank and piping integrity by **[date]** (call us immediately to discuss "pre-approval" of this work to ensure that it may be considered for reimbursement),

and/or

(2) performing a "Site Check" to measure for the presence of a release,

and

(3) notifying this office of positive or negative confirmation of a release **within 24 hours**, followed by submittal of a report of your Release Investigation and Confirmation Steps by **[date]**. If the release has been confirmed, we will then advise you of further required actions.

The Virginia Petroleum Storage Tank Fund (VPSTF) may reimburse RP's for **some** corrective action costs incurred. Prior approval of site work is required if you plan to seek reimbursement for this pollution event. Prior approval is accomplished by submitting an Activity Authorization Package to this office. This Package should be submitted to this office by **[date]**. Certain emergency activities do not require prior authorization within specified limits. Any activities performed more than **24 hours prior** to the date this release was reported are INELIGIBLE for reimbursement.

Page 2

Date

Please refer to the enclosed fact sheets for more information on Suspected Releases, the Activity Authorization Package, VPSTF Reimbursement and other program requirements for petroleum storage tanks. The Reimbursement Manual and other materials are also available from this office.

After we have reviewed your report, we may: (1) close this case, (2) request additional information, or (3) require submittal of a Site Characterization Report that describes the nature, extent, risk, and potential for remediation of any petroleum contamination present. It is important that you maintain close contact with DEQ while conducting this investigation, and that all required reports are submitted by the appropriate deadlines.

We at DEQ are very interested in assisting you in any way possible to conduct a rapid, effective, and efficient release investigation. If you have any questions, please contact me at **[phone number]**.

Sincerely,

Case Manager

Enclosures:  
Activity Authorization Form,  
program Fact Sheets, program manual (optional),  
program materials list (optional)

(Revised 2/7/01)

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October 4, 2001

### **Requirements for Confirmed Release Letters**

- Identify PC#,
- Date of RP confirmed release notification,
- Identify recipient as RP,
- Reference State Law,
- Include the language: "...the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 23 and 9 VAC 25-580-10 et seq."
- List due dates for submittal of the Initial Abatement Report (if required by Regional Office) and the Site Characterization Report. The IAR deadline should be within 20 days or other reasonable period of time as specified by the Case Manager. The SCR deadline should be within 45 days or other period of time as specified by the Case Manager.
- Notify RP that Activity Authorization Form required for reimbursement,
- Notify RP that certain emergency actions do not require prior authorization,
- Notify RP that activities performed 24 hours prior to the report date are ineligible for reimbursement,
- Include Attachments:
  - Activity Authorization Form
  - Program Fact Sheets.

(Revised 2/7/01)

Example Letter  
Confirmed Release from Petroleum Storage Tank(s)

Date

addressee

re:                                      Site name and location  
Facility and Tank Identification:  
DEQ Tracking Number: PC#

Dear :

Thank you for notifying the Department of Environmental Quality (DEQ) on **[date]** of a petroleum release at the referenced site. Based on the evidence available to us, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 23 and 9 VAC 25-580-10 et seq. has determined that you are the Responsible Person (RP) for this petroleum release. This means that you are responsible for the environmental corrective action activities associated with this release as required by State Water Control Law (Articles 9, 10, and 11 of the Virginia Code, Section 62.1-44.34:8 through :23, inclusive). Your responsibilities include:

- (1) taking any necessary initial abatement measures to mitigate the effects of the release (eliminate the source, remove free-phase petroleum contamination, remove limited quantities of petroleum saturated soils, and eliminate any immediate safety and environmental hazards) and submitting an Initial Abatement Measures Report to this office by **[date]**.
- (2) conducting an investigation of the source, extent, and risk posed by the release, and
- (3) submitting a Site Characterization Report (SCR), and, if necessary, a Free Product Removal Report, to this office by **[date]**.

The recommended elements for these reports are available in the Storage Tank Program Technical Manual. If a discussion of these elements does not adequately describe your site conditions and cleanup rationale, include additional information as necessary to complete the report.

The Virginia Petroleum Storage Tank Fund (VPSTF) may reimburse RP's for some corrective action costs incurred. Prior approval of site work is required if you plan to seek reimbursement for this pollution event. Prior approval is accomplished by submitting an Activity

Page 2

Date

Authorization Package to this office. This Package should be submitted to this office by **[date]**. Certain emergency activities do not require prior authorization within specified limits. Any activities performed more than **24 hours prior** to the date this release was reported are INELIGIBLE for reimbursement.

Please refer to the enclosed fact sheets for a more information on Confirmed Releases, the Activity Authorization Package, VPSTF Reimbursement and other program requirements for petroleum storage tanks. The Reimbursement Manual and other materials are also available from this office.

DEQ recommends that RP's who are not familiar with Virginia's environmental corrective action procedures consider hiring an environmental consultant. The consultant you select should demonstrate knowledge of Virginia's technical and administrative requirements under this program, experience with situations similar to yours, and justification of their proposed costs.

After we have received and reviewed your SCR, we may: (1) close this case, (2) request additional information, (3) require periodic monitoring of site conditions, or (4) require submittal of a Corrective Action Plan for cleanup. It is important that you maintain close contact with DEQ while conducting this cleanup, and that all required reports are submitted by the appropriate deadlines.

We at DEQ are very interested in assisting you in any way possible to conduct a rapid, effective, and efficient release investigation. If you have any questions, please contact me at **[phone number]**.

Sincerely,

Case Manager

Enclosures:  
Activity Authorization Form,  
program Fact Sheets, program manual (optional),  
program materials (optional)

(Revised 2/7/01)

Example Letter:

Discharge of oil from a small heating oil tank

Category 1 sites

Date

Addressee

RE: Discharge of oil from a small heating oil tank  
DEQ tracking number **PC#**\_\_

Dear \_\_\_\_\_:

Thank you for notifying the Department of Environmental Quality (DEQ) on **[date]** regarding a discharge of oil at the referenced site. To resolve this matter, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:14 through 23, will be working with you to investigate the severity of the discharge and determine the clean up actions that are necessary.

Based upon the information provided about the discharge, the investigation will proceed as a Category 1 Small Heating Oil Tank Cleanup. In order to initiate the investigation and reimbursement processes, you must submit an Activity Authorization Package to this office by **[date]**. The completed Activity Authorization Package must include: (1) a completed Activity Authorization Form (AAF, enclosed); (2) an initial site sketch; and (3) a copy of a topographic map indicating the site location.

The Small Heating Oil Tank Release Characterization Report Form (enclosed) must be completed and returned to this office by **[date]**. Early submittal of the Activity Authorization Package will assure sufficient time to complete the site work and prepare the Small Heating Oil Release Characterization Report Form. Unless an emergency situation exists at the site, you should not proceed with environmental site assessment work until the AAF has been approved by this office.

The Virginia Petroleum Storage Tank Fund (VPSTF), also administered by DEQ, may be available to reimburse you for costs to investigate and clean up the release (VPSTF Fact Sheet enclosed). Please note that prior approval of site work is required if you plan to seek reimbursement. Prior approval is obtained by submitting an AAF to this office before investigation and clean up activities are initiated. You are not required to obtain pre-approval for conducting activities needed to abate immediate hazards, however, it is highly recommended that you contact this office as soon as possible should an emergency situation occur. Any activities performed more than 24 hours before the date this discharge was reported are ineligible for reimbursement.

Page 2

Date

DEQ recommends that persons who are not familiar with Virginia's environmental corrective action procedures consider hiring an environmental consultant. The consultant should: (1) demonstrate knowledge of Virginia's technical and administrative requirements under this program; (2) have experience with situations similar to yours; and (3) provide a justification of work to be performed and the costs for performing that work.

This office will assist you in completing a rapid and effective release investigation. We do request that all correspondence submitted for this site contain the tracking number [PC#] referenced above. If you have any questions, please feel free to call me at **[phone number]**.

Very truly yours,

Case Manager

Enclosures:    AAF Category 1 Heating Oil Discharges  
                     Small Heating Oil Release Characterization Report Form  
                     Fact Sheet: Virginia Petroleum Storage Tank Fund (VPSTF)

Revised (4/1701)

Example Letter:

Discharge of oil from a small heating oil tank

Category 2 sites

Date

Addressee

RE: Discharge of oil from a small heating oil tank  
DEQ tracking number **PC#**\_\_

Dear \_\_\_\_\_:

Thank you for notifying the Department of Environmental Quality (DEQ) on **[date]** regarding a discharge of oil at the referenced site. To resolve this matter, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:14 through 23, will be working with you to investigate the severity of the discharge and determine the clean up actions that are necessary.

Based upon the information available at this time, the investigation at this site will proceed as a Category 2 Small Heating Oil Tank discharge. Your responsibilities include:

1. Taking the actions necessary to stop the discharge and abate and mitigate any immediate hazards caused by the discharge. This includes stopping any continued discharge of oil from the tank into the environment, removing free product, and eliminating immediate safety or environmental hazards (fire, vapors in buildings, oil on surface water, etc.).
2. Investigating the severity and extent of the release, evaluating the risks posed by the release, and determining what actions are necessary to clean up the release. A Site Characterization Report (SCR) assessing contamination, risks, and clean up alternatives must be submitted to this office by **[date]**.

In order to initiate the investigation and reimbursement processes, you must submit an Activity Authorization Package to this office by **[date]**. The Activity Authorization Package should include: (1) the completed Activity Authorization Form (AAF, enclosed); (2) a sketch of the site; and (3) a copy of a topographic map indicating the site location. Early submittal of the Activity Authorization Package will assure sufficient time to complete the site work and prepare the SCR. Unless an emergency situation exists at the site, you should not proceed with environmental site assessment work until the AAF has been approved by this office.



Page 2

Date

The Virginia Petroleum Storage Tank Fund (VPSTF), also administered by DEQ, may be available to reimburse you for costs to investigate and clean up the release (VPSTF Fact Sheet enclosed). Please note that prior approval of site work is required if you plan to seek reimbursement. Prior approval is obtained by submitting an AAF to this office before investigation and clean up activities are initiated. You are not required to obtain pre-approval for conducting activities needed to abate immediate hazards, however, it is highly recommended that you contact this office as soon as possible should an emergency situation occur. Any activities performed more than 24 hours before the date this release was reported are ineligible for reimbursement.

DEQ recommends that persons who are not familiar with Virginia's environmental corrective action procedures consider hiring an environmental consultant. The consultant should: (1) demonstrate knowledge of Virginia's technical and administrative requirements under this program; (2) have experience with situations similar to yours; and (3) provide a justification of work to be performed and the costs for performing that work.

This office will assist you in completing a rapid and effective release investigation. We do request that all correspondence submitted for this site contain the tracking number [PC#] referenced above. If you have any questions, please feel free to call me at [phone number].

Very truly yours,

Case Manager

Enclosures:    AAF for a Category 2 Small Heating Oil Discharge  
                    Fact Sheet: Virginia Petroleum Storage Tank Fund (VPSTF)

Revised (4/17/01)

Example Letter:

Discharge of oil from a small heating oil tank

Category 3 sites

Date

Addressee

RE: Discharge of oil from a small heating oil tank  
DEQ tracking number **PC#**\_\_

Dear \_\_\_\_\_:

Thank you for notifying the Department of Environmental Quality (DEQ) on **(date)** regarding a discharge of oil at the referenced site. To resolve this matter, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:14 through 23, will be working with you to investigate the severity of the discharge and determine the clean up actions that are necessary. Your responsibilities include:

1. Taking the actions necessary to stop the discharge and abate and mitigate any immediate hazards caused by the discharge. This includes stopping any continued discharge of oil from the tank into the environment, removing free product, and eliminating immediate safety or environmental hazards (fire, vapors in buildings, oil on surface water, etc.). An Initial Abatement Report (may be requested at Case Manager's discretion), documenting the measures taken to abate hazards at the site must be submitted to this office by **[date]**. A list of elements usually needed in an Initial Abatement Report are enclosed.
2. Investigating the severity and extent of the release, evaluating the risks posed by the release, and determining what actions are necessary to clean up the release. A Site Characterization Report (SCR) assessing contamination, risks, and clean up alternatives must be submitted to this office by **[date]**. The recommended elements of a Site Characterization Report are enclosed.

The Virginia Petroleum Storage Tank Fund (VPSTF), also administered by DEQ, may be available to reimburse you for costs to investigate and clean up the release (VPSTF Fact Sheet enclosed). Please note that prior approval of site work is required if you plan to seek reimbursement. Prior approval is obtained by submitting an Activity Authorization Form (AAF; enclosed) to this office before investigation and clean up activities are initiated. You are not required to obtain pre-approval for conducting activities needed to abate immediate hazards, however, it is highly recommended that you contact this office as soon as possible should an emergency situation occur. Any activities performed more than 24 hours before the date this release was reported are ineligible for reimbursement.

Page 2

Date

In order to initiate the investigation and reimbursement processes, you must submit an Activity Authorization Package to this office by **[date]**. The Activity Authorization Package should include: (1) the completed AAF; (2) a sketch of the site; and (3) a copy of a topographic map indicating the site location. Early submittal of the Activity Authorization Package will assure sufficient time to complete the site work and prepare the SCR. Unless an emergency situation exists at the site, you should not proceed with environmental site assessment work until the AAF has been approved by this office.

DEQ recommends that persons who are not familiar with Virginia's environmental corrective action procedures consider hiring an environmental consultant. The consultant should: (1) demonstrate knowledge of Virginia's technical and administrative requirements under this program; (2) have experience with situations similar to yours; and (3) provide a justification of work to be performed and the costs for performing that work.

This office will assist you in completing a rapid and effective release investigation. We do request that all correspondence submitted for this site contain the tracking number **[PC#]** referenced above. If you have any questions, please feel free to call me at **[phone number]**.

Very truly yours,

Case Manager

Enclosures:    AAF  
                    Fact Sheet: Elements of an Initial Abatement Report (if required by the RO)  
                    Fact Sheet: Elements of a Site Characterization Report  
                    Fact Sheet: Virginia Petroleum Storage Tank Fund (VPSTF)

(revised 4/17/01)

## **Requirements for Small Heating Oil Discharge Letters**

- Identify PC#,
- Date of RP confirmed release notification,
- Identify recipient as RP,
- Include the language:  
"...the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:14 through 23, will be working with you to investigate the severity of the discharge and determine the clean up actions that are necessary."
- Identify the discharge Category
- Enclose the appropriate AAF
- If Category 1 site: Enclose the Small Heating Oil Release Characterization Report Form
- Provide due dates for the Activity Authorization Package, Initial Abatement Report (if required for Category 3 site), and Site Characterization Report (or form). The IAR deadline should be within 20 days or other reasonable period of time as specified by the Case Manager. The SCR deadline should be within 45 days or other period of time as specified by the Case Manager.
- Notify RP that Activity Authorization Form required for reimbursement,
- Notify RP that certain emergency actions do not require prior authorization,
- Notify RP that activities performed 24 hours prior to the report date are ineligible for reimbursement,

Revised (4/17/01)

## Example Letter

### Petroleum Storage Tank Amended Notification Form for Permanent Tank Closure(s)

Date

addressee

re:      Site Name/Location:  
         Facility and Tank Identification:

Dear M:

Thank you for providing your amended notification form and supporting information documenting the permanent closure of your tank(s) to the Department of Environmental Quality (DEQ).

Based upon the tank closure information you have provided, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 9 and 9 VAC 25-580-10 et seq. believes that contamination levels at this site do not warrant further assessment. Should future environmental problems occur, which the DEQ determines are related to this site, additional investigation and corrective action may be required in accordance with State Law.

If you have any questions regarding this matter, please contact me at **[phone number]**.

Sincerely,

Case Manager

(Revised 2/7/01)

Example Letter:  
Case Closure after completion of the SCR

Date

addressee

re:     Site Name/Location:  
          Facility and Tank Identification:  
          DEQ Tracking Number: PC#

Dear \_\_\_\_\_:

Thank you for providing an Initial Abatement Report dated **[report date]** and Site Characterization Report dated **[report date]** for the referenced site to the Department of Environmental Quality (DEQ). Based upon the information you have provided, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 9 and 9 VAC 25-580-10 et seq. believes that contamination levels at this site do not warrant further corrective action. This pollution complaint case is now closed. Should future environmental problems occur, which the DEQ determines are related to this release, additional investigation and corrective action may be required in accordance with State Law.

In order to reduce future risks to ground water, all monitoring wells at the site must be properly abandoned. Please submit an AAF for abandoning monitoring wells to this office by **[date]**.

[Optional Paragraph]

**Virginia Law prohibits the payment of corrective action and third party liability reimbursement claims which are filed more than two years after DEQ closes a case. All claims for this release must be received by DEQ no later than DATE (list the date that is two years after the date of this closure letter) in order to be eligible for reimbursement.**

If you have any questions regarding this matter, please contact **[Case Manager]** at **[phone number]**.

Sincerely,

Remediation Manager or Compliance and Enforcement  
Manager

(Revised 2/7/01)

Example Letter:  
Case Closure after completion of Corrective Actions

Date

addressee

re: Site Name/Location:  
Facility and Tank Identification:  
DEQ Tracking Number: PC#

Dear :

The DEQ believes that endpoints established in the Corrective Action Plan (CAP) for the referenced site have been met and no further corrective action is necessary. Based upon the information you have provided regarding site conditions, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 9 and 9 VAC 25-580-10 et seq. considers this case is closed. You are no longer constrained by the CAP requirements and are free to remove the cleanup system and all monitoring points covered by this CAP. Please be advised, should future environmental problems occur, which the DEQ determines are related to this release, corrective action may be required in accordance with State Law.

In order to reduce future risks to ground water at the site, all monitoring wells must be properly abandoned. Please submit an AAF for abandoning monitoring wells and removing the remediation system to this office by **[date]**.

[Optional Paragraph]

**Virginia Law prohibits the payment of corrective action and third party liability reimbursement claims which are filed more than two years after DEQ closes a case. All claims for this release must be received by DEQ no later than DATE (list the date that is two years after the date of this closure letter) in order to be eligible for reimbursement.**

The Department of Environmental Quality thanks you for completing the Corrective Action Plan and appreciates your efforts and cooperation in cleaning up this site. If you have any questions regarding this matter, please contact **[Case Manager]** at **[phone number]**.

Sincerely,

Remediation Manager or Compliance and Enforcement  
Manager

(Revised 2/7/01)

Example Letter:  
Case Closure of Home Heating Oil Tank Discharge

Date

addressee

re:      Site Name/Location:  
         DEQ Tracking Number: PC#

Dear \_\_\_\_:

Thank you for reporting a discharge of oil on **[report date]** for the referenced site. Based upon the available information, the State Water Control Board acting through the Department of Environmental Quality (DEQ), as authorized by CODE § 62.1-44.34:14 through 23 has determined that contamination levels at this site do not warrant further corrective action. This pollution complaint case is now closed. Should future environmental problems occur, which the DEQ determines are related to this discharge, additional investigation and corrective action may be required in accordance with State Law.

In order to reduce future risks, the DEQ recommends that you contact the local building official and properly close the subject tank.

[Optional paragraph]

Virginia Law prohibits the payment of corrective action and third party liability reimbursement claims that are filed more than two years after DEQ closes a case. All claims for this release must be received by DEQ no later than **[date]** (list date that is two years after the date of this closure letter) in order to be eligible for reimbursement.

If you have any questions regarding this matter, please contact **[Case Manager]** at **[phone number]**.

Sincerely,

Remediation Manager or Compliance and Enforcement  
Manager

(Revised 3/15/01)



## Requirements for Case Closure Letters

- Identify PC#,
- Include the language: "Based upon the information provided, the State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 9 and 9 VAC 25-580-10 et seq. considers this case closed."

**NOTE: Change the Code citation to 62.1-44.34:14 through 23 and remove the 9 VAC 25-580-10 et seq. citation for Article 11 case closures.**

- Use the following case closure language in the body of the letter for amended notification forms for tank closure and Corrective Action reports (IAR and SCR):

...contamination levels at this site do not warrant further assessment [or corrective action]. Should future environmental problems occur, which the DEQ determines are related to this site [or release/discharge], additional investigation and corrective action may be required in accordance with State Law.

- Use the following case closure language in the body of the letter for completion of a CAP and termination of coverage under a CAP General permit:

...endpoints established in the Corrective Action Plan for the above reference site have been met and no further corrective action is necessary. Please be advised, should future environmental problems occur, which the DEQ determines are related to this release, corrective action may be required in accordance with State Law.

- Inform the RP that monitoring wells at the site must be abandoned.

- Signatory Authority for Case Closure:

The letter must be signed by the Remediation Manager or the Compliance and Enforcement Manager. If this person is absent from the Regional Office for more than one day, the Case Manager may sign the letter. (See Agency Policy Statement No. 6-2000, Delegation of Authority, April 10, 2000).

[optional paragraph]

- **Virginia Law prohibits the payment of corrective action and third party liability reimbursement claims which are filed more than two years after DEQ closes a case. All claims for this release must be received by DEQ no later than DATE (list the date that is two years after the date of this closure letter) in order to be eligible for reimbursement.**

(revised 3/15/01)

Example Letter:  
Interim Authorization to Initiate Corrective Action

Date

Addressee

re:     Site Name/Location:  
        Facility and Tank Identification:  
        DEQ Tracking Number: PC#

Dear \_\_\_\_\_:

Thank you for submitting a request to initiate corrective actions and **[document name, date]** describing the proposed corrective actions to the Department of Environmental Quality (DEQ). We have reviewed your request and based upon information presented to and obtained by this office, we believe that the initiation of corrective action at the subject site will protect human health and promote a more effective cleanup at the site. The State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 9 and 9 VAC 25-580-10 et seq. grants (regulated USTs only) **[RP Name]** Interim Authorization to proceed with the corrective actions outlined in **[document name and date]**. These corrective actions shall not result in a discharge to surface water unless DEQ has issued coverage for the discharge under a general or individual VPDES permit.

Please determine the scope of work and materials needed to implement the corrective actions outlined in **[document name, date]** and provide an AAF and Bid Summary Form (if applicable) to this office by **[date]**. Tasks and materials listed on the UCR Schedule may be listed on the AAF. Materials and equipment not listed on the UCR Schedule that will cost more than \$500 over the duration of CAP Implementation must be listed on the Bid Summary Form, assigned a scope of work number, and bid. For additional information about bidding requirements and procedures, please see the VPSTF Reimbursement Manual.

Persons conducting corrective actions under Interim Authorization granted by DEQ must comply with all conditions imposed by DEQ including halting cleanup and/or mitigating adverse consequences from cleanup activities. Please be aware that all actions taken under Interim Authorization must be incorporated into a Corrective Action Plan for the site (9 VAC 25-580-280) and that additional corrective actions may be required to protect human health and the environment at this site.

If you have any questions, please feel free to contact **[DEQ Case Manager]** at **[phone number]**.

Very truly yours,

Remediation Manager or Compliance and Enforcement Manager

(revised 2/7/01)

## **Requirements for Interim Authorization Letters**

- List Pollution complaint #
- If the release was from a regulated UST, reference the section of the regulation where Interim Authorization may be granted (9 VAC 25-580-280.E)
- Include the language: " The State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 9 and 9 VAC 25-580-10 et seq. grants...Interim Authorization to proceed with corrective action..."
- The RP cannot discharge to surface water unless they have coverage under a general or individual VPDES permit for the discharge
- Remind the RP that they need to submit an AAF and Bid Summary form (if applicable) and provide a due date
- All corrective actions performed under Interim Authorization must be incorporated into a CAP
- Signatory Requirements:  
The letter must be signed by the Remediation Manager or the Compliance and Enforcement Manager. If this person is absent from the Regional Office for more than one day, the Case Manager may sign the letter. (See Agency Policy Statement No. 6-2000, Delegation of Authority, April 10, 2000).

(revised 2/7/01)

Example Letter:  
Request for Corrective Action Plan

Date

Addressee

RE: Site Name, Address  
Facility and Tank Identification  
PC#

Dear \_\_\_\_:

Thank you for submitting a Site Characterization Report dated **[report date]** to the Department of Environmental Quality (DEQ). The State Water Control Board acting through the DEQ, as authorized by CODE § 62.1-44.34:8 through 9 and 9 VAC 25-580-10 et seq., has reviewed the Site Characterization Report (SCR) along with other information provided for the site and determined that corrective action is needed at this site to address the following:

1. the removal of free product (example)
2. petroleum vapors in the building on site (example)
3. ....

Please provide a Corrective Action Plan (CAP) for addressing the above issues to this office by **[date]**. Prior approval of work is required if you plan to seek reimbursement for the preparation of the CAP. Prior approval may be obtained by submitting an AAF to this office. The AAF listing the tasks and materials needed to complete the CAP must be submitted to this office no later than **[date]**.

Please feel free to contact me at **[phone #]** if you have any questions.

Sincerely,

Case Manager

Enclosures  
cc:

(revised 2/7/01)

Example Letter:

Letter directing RP to obtain coverage under General VPDES Permit for Petroleum Contaminated Sites

Date

Addressee

re:     Site Name/Location:  
          Facility and Tank Identification:  
          DEQ Tracking Number: PC#

Dear \_\_\_\_:

Information presented to or known by Department of Environmental Quality (DEQ) staff indicates that one or more activities planned for the referenced site may cause a discharge of petroleum contaminated water into surface water. In order to ensure the protection of human health and the environment, DEQ believes that these activities need to be covered under the General VPDES Permit for Petroleum Contaminated Sites (*staff may, at their discretion, list specific activities that they believe need to be permitted*).

Please complete the General VPDES Permit Registration Statement and return it to this office by **[date]**. Instructions for completing the Registration Statement are also enclosed.

If you have any questions, please feel free to call me at **[phone number]**.

Very truly yours,

DEQ Case Manager

enclosures     Petroleum General Permit Regulation (9 VAC 25-120-10 et seq.)  
                  Registration Statement  
                  Instructions for completing the Registration Statement

(revised 2/2/99)

Example Letter:  
Transmittal Letter for Petroleum Discharge General Permit

Date

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

Addressee

RE: Coverage under the General VPDES Permit for Petroleum Contaminated Sites  
**VAG83 fill in 4 digit tracking #**  
**Site Name and Address**  
**PC#**

Dear \_\_\_\_\_:

We have reviewed your Registration Statement received on **[date]** and determined that the **[discharge(s)]** outlined on that statement **is/are** hereby covered under the referenced general VPDES permit. The effective date of your coverage under this general permit is the date of this letter. The enclosed copy of the general permit contains the applicable effluent limitations, monitoring requirements and other conditions of coverage.

The permit requires effluent sampling and reporting on a monthly basis. Discharge monitoring Reports (DMRs) that you may use to report sampling results are enclosed. You are responsible for making additional copies of the DMR(s) as needed. Separate DMRs must be completed for each permitted outfall and DMRs must be submitted for each outfall regardless of whether a discharge from that outfall occurred during the previous month. If a discharge did not occur from a particular outfall during the previous month, please write "no discharge" on the DMR. You are required to submit completed DMRs by the 10th of each month to:

**Compliance Auditor**  
**Regional Office Address**

**Insert the following paragraph if wastewater will be treated or stored prior to discharge**

Information provided on the Registration Statement indicates that wastewater will be discharged through a treatment works. Within 30 days of the date of this letter, you are required to develop and maintain on site an Operation and Maintenance (O&M) Manual for this permitted treatment works (see Part I.B.3 of the Permit).

Page 2

The General VPDES Permit for Petroleum Contaminated Sites will expire on February 24, 2003. The conditions of the permit require that you submit a new registration statement no later than 180 days prior to the date of permit expiration if you wish to continue coverage under the permit.

If you wish to terminate permit coverage for inactive outfalls or the entire site, please fill out the enclosed Termination of Coverage Request form and send it to **[Case Manager]** at the address listed above.

Please review the enclosed materials carefully. If you have any questions, please call **[Case Manager]** at **[phone number]**.

Very truly yours,

**Remediation Manager or Compliance and  
Enforcement Manager**

Enclosures:      Discharge Monitoring Reports  
                         Permit Cover Page  
                         Applicable Effluent Limitations and Monitoring Requirements  
                         Parts I.B and II of the Permit  
                         Termination of Coverage Request form

(revised 2/2/99)

## **Requirements for Transmittal Letter Petroleum General Discharge Permit**

- Identify Permit #
- List site name and address
- List PC#
- The effective date of coverage under the permit is the date of the transmittal letter
- Remind permittee that they are required to submit DMRs, on a monthly basis, for each outfall
- If used oil contributed to contamination at the site
  1. Direct permittee to submit analytical results for semivolatile organics, volatile organics, and dissolved metals along with the first set of DMRs. These results should be included with the DMRs but not be written on the DMRs.
  2. The permittee must collect samples for semivolatile, volatile, and metal constituents within 72 hours of initiating the discharge
  3. Remind permittee that they only need to analyze samples for semivolatiles, volatiles, and metals once per year.
- Inform permittee that copies of the DMRs are enclosed and the permittee is responsible for making additional copies of the DMRs
- Instruct permittee where to send DMRs
- Remind the permittee that they must develop and maintain an O&M Manual at the site if they will treat or store wastewater prior to discharge.
- Inform permittee that if they wish to terminate permit coverage for inactive outfalls or the entire site, they should fill out the enclosed Termination of Coverage Request form and send it to the Case Manager
- Send letter via Certified Mail with Return Receipt Requested
- Signatory Requirements

The letter must be signed by the Remediation Manager or the Compliance and Enforcement Manager. If this person is absent from the Regional Office for more than one day, the Case Manager may sign the letter. (See Agency Policy Statement No. 6-2000, Delegation of Authority, April 10, 2000).
- Enclosures

Discharge Monitoring Reports  
Permit Cover Page  
Applicable Effluent Limitations and Monitoring Requirements  
Parts I.B and II of the Permit  
Termination of Coverage Request form

(revised 12/1/00)



Example Letter

Termination of Coverage Under the General VPDES Permit for Petroleum Contaminated Sites

Date

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

Addressee

RE: Coverage under the General VPDES Permit for Petroleum Contaminated Sites  
**VAG83 fill in 4 digit tracking #**  
**Site Name and Address**  
**PC#**

Dear \_\_\_\_\_:

Thank you for submitting a request to terminate coverage under the referenced permit. We have reviewed your request and coverage under the referenced permit is hereby terminated for : **fill in information from A or B below**

**A. all surface water discharges at the referenced site**

**B. the following outfalls**

<b>1. outfall #</b>	<b>outfall description (e.g. tank pit dewatering)</b>
<b>2. outfall #</b>	<b>outfall description</b>

The effective date of termination of coverage for the activities listed above is the date of this letter.

If you have any questions, please call [**Case Manager**] at [**phone number**].

Very truly yours,

**Remediation Manager or Compliance and  
Enforcement Manager**

(revised 2/2/99)

## **Letter Requirements for Termination of Coverage Under the Petroleum General VPDES Permit**

- List the Permit #
- Identify the site name and location
- List the PC#
- Identify whether coverage is being terminated for the entire site or for specific outfalls. If specific outfalls are being terminated, it is recommended that you list each outfall that is being terminated by both outfall number and description (e.g. outfall 003 - pump test)
- Signatory Authority:  
The letter must be signed by the Remediation Manager or the Compliance and Enforcement Manager. If this person is absent from the Regional Office for more than one day, the Case Manager may sign the letter. (See Agency Policy Statement No. 6-2000, Delegation of Authority, April 10, 2000).

(revised 12/1/00)

## **APPENDIX F**

### **Responsible Person Determination Worksheet**

## Responsible Person Determination Worksheet

### I. Site Information

Site Name \_\_\_\_\_

Site Address \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Telephone Number \_\_\_\_\_

Facility ID# \_\_\_\_\_ PC # \_\_\_\_\_

### II. Tank Information: (check one)

UST Type:      Regulated, Deferred, Partially Deferred \_\_\_\_\_  
                     Excluded \_\_\_\_\_  
                     Exempt (except home heating oil) \_\_\_\_\_  
                     Home heating oil \_\_\_\_\_

AST Type:      Greater than 660 gal. oil \_\_\_\_\_  
                     Oil tank of 660 gal. or less (except home heating oil) \_\_\_\_\_  
                     home heating oil tank of 660 gal. or less \_\_\_\_\_

### III. Leaking Tank Status

\_\_\_ Currently in use

\_\_\_ No longer in use      \_\_\_\_\_ Date last used

\_\_\_ Removed      \_\_\_\_\_ Date removed

### IV. Responsible Person

#### A. Release(s) from Regulated, Deferred, Partially Deferred, and Excluded USTs

1. If a Notification Form been submitted to DEQ, the UST owner listed on the form is presumed to be the Responsible Person. List the tank owner's name, address, and phone number below, then go to Part V.

2. If a Notification Form has not been submitted for the site or the release was from an excluded UST, the person who owned the property at the time of the release is presumed to be the responsible person. List this person's name, address, and phone number below, then go to Part V.

**B. Discharges from ASTs with a capacity of greater than 660 gallons of oil**

1. If the discharge was caused by a person (the spiller) and the spiller is known, the spiller is the RP. List this person's name, address, and phone number below, then go to Part V.
2. If the discharge was not caused by a spiller go to the AST Registration Form.
  - a. The RP is the person listed on the AST Registration Form as the AST operator (person responsible for the day-to-day operation of the AST). List this person's name, address, and phone number.
  - b. If the AST operator no longer exists or cannot be found, the person listed on the Registration Form as the AST owner is the RP. List this person's name, address, and phone number, then go to Part V.
3. If there is neither a known spiller nor a Registration Form for the tank, presume that the property owner at the time of the discharge is the AST or facility operator and the responsible person. List this person's name, address, and phone number below, then go to Part V.

**C Discharges from home heating oil ASTs of 660 gallons or less and home heating oil USTs (i.e. small home heating oil tanks)**

1. If the discharge was caused by a person (the spiller) and the spiller is known, the spiller is the RP. List this person's name, address, and phone number below, then go to Part V.

2. If the discharge was not caused by a spiller or if the spiller cannot be found, the tank owner is the RP. The present property (facility) owner is presumed to be the tank owner. List the property owner's name, address, and phone number below, then go to part V.

**V. Documentation potentially affecting the responsible person determination.**

- |   |  |
|---|--|
| <input type="checkbox"/> Deed             | <input type="checkbox"/> DEQ Notification or Registration Form   |
| <input type="checkbox"/> Bill of Sale     | <input type="checkbox"/> UST or AST removed by a prior owner<br>(documentation must be provided)   |
| <input type="checkbox"/> Lease            | <input type="checkbox"/> UST removed or last used prior to 11/8/84 that was owned by<br>someone other than the person listed in IV.2, above. (documentation<br>must be provided) |
| <input type="checkbox"/> Service Contract | <input type="checkbox"/> Other (explain)   |

Do any of these documents demonstrate that someone other than the person listed in Part IV owns the UST or small home heating oil tank or operates the AST or exempt UST (except for home heating oil USTs)? If yes, list the name, address, and telephone number of the Responsible Person below. If no, the person listed in Part IV is the Responsible Person.

NOTE: Questions regarding Responsible Person Determination should be directed to the Financial Programs Manager in OSRR.

(revised 7/10/01)

## **APPENDIX G**

**Reserved**

## **APPENDIX H**

### **Worksheet for Occurrence Determination**



## WORKSHEET FOR OCCURRENCE DETERMINATION

(Date Written 12/13/95)

Site Name: \_\_\_\_\_

Site Location: \_\_\_\_\_ PC#: \_\_\_\_\_

1. Does the type of contamination at the site include the following:

petroleum from USTs (regulated, excluded, deferred, partially deferred,  
exempt 1 & 2);

gasoline, diesel, kerosene, and/or heating oil from ASTs (regulated facility,  
unregulated facility) for which the VPSTF-fee was levied; and/or

heating oil from a small heating oil AST.

YES NO

If you answered NO to question 1 STOP; the release is not eligible for reimbursement from the VPSTF.

2. Were all releases reported prior to the due date of the first SCR required by  
the Regional Office?

YES NO

3. Is there only one owner/entity for the tanks with the releases?

YES NO

If you answered YES to questions 2 and 3 determine the number of occurrences using the table in item 4 below. If you answered NO to question 2 or 3; go to the next page and complete items 5 through 7.

4. Under TANK TYPE circle the tank type(s) with releases. Under OCCURRENCE circle "YES" if there are release(s) within an Group and "NO" if there is not a release within a Group. Each "YES" is one occurrence.

GROUP	TANK TYPES	OCCURRENCE
1	Petroleum Regulated UST, Excluded UST, Deferred UST, Partially Deferred UST	YES NO
2	Exempt UST 1, Exempt UST 2, Small Heating Oil AST	YES NO
3	Regulated AST Facility, Unregulated AST Facility	YES NO

Total Occurrences \_\_\_\_\_

If part of the contamination is the result of a release from any of the following:

1. an UST which contained a non-petroleum substance,
2. an AST which contained Non-Fee Products, and/or
3. an AST loading rack and/or parking area,

inform the RP that the costs resulting from these releases are ineligible for reimbursement and identify work which is eligible for reimbursement.

5. List the tank type(s) with releases that were addressed in the first SCR by tank group and tank owner(s).

Give one occurrence to tanks within the same group that were owned by the same responsible person.

Tank Owner	Tank Group 1	Tank Group 2	Tank Group 3	Total

Do any of the SCRs prepared for the site address releases that were not addressed in the first SCR? If yes, go to 6. If no, go to 7.

6. For each SCR or SCR Addendum submitted after the first SCR, list the tank type(s) by tank group(s) and tank owner(s) for releases that were addressed in that report and not in previously submitted reports.

Give one occurrence to tanks within the same group that were owned by the same responsible person.

Tank Owner	Tank Group 1	Tank Group 2	Tank Group 3	Total

Repeat step 6 as necessary to determine the total number of occurrences at a site

7. Add the occurrences for each tank owner person identified in 5 and 6.

Tank Owner \_\_\_\_\_ Total Occurrences \_\_\_\_\_

Tank Owner \_\_\_\_\_ Total Occurrences \_\_\_\_\_

Tank Owner \_\_\_\_\_ Total Occurrences \_\_\_\_\_

If part of the contamination is the result of a release from any of the following:

1. an UST which contained a non-petroleum substance,
2. an AST which contained Non-Fee Products,
3. an AST loading rack and/or parking area,

inform the RP that the costs resulting from these releases are ineligible for reimbursement and identify work which is eligible for reimbursement.

---

## **APPENDIX I**

### **Activity Authorization Forms 198, 395, 1289, Category 1 & 2 Small Heating Oil Tank**

The Activity Authorization Forms are part of the Virginia Petroleum Storage Tank Fund Reimbursement Guidance Manual. To obtain electronic copies of the Activity Authorization Forms, please download Volume I of the Reimbursement Manual from the DEQ web page at: [www.DEQ.state.va.us](http://www.DEQ.state.va.us)

From the DEQ home page, select "Petroleum Programs" from the topics on the left side of the screen. On the Petroleum Programs web page, select "Download Library." Next, select "Reimbursement Files - Manuals/UCRS" and download Volume I of the Reimbursement Guidance Manual

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## APPENDIX J

### Usual and Customary Rates (UCRs)

The Usual and Customary Rates (UCRs) comprise Volume II of the Virginia Petroleum Storage Tank Fund Reimbursement Guidance Manual. Volume II of the Reimbursement Manual may be downloaded from the DEQ web page at:

[www.DEQ.state.va.us](http://www.DEQ.state.va.us)

From the DEQ home page, select "Petroleum Programs" from the topics on the left side of the screen. On the Petroleum Programs web page, select "Download Library." Next, select "Reimbursement Files - Manuals/UCRS" and download Volume II of the Reimbursement Guidance Manual

## **APPENDIX K**

### **Work Verification Checklist**

## Work Verification Checklist

(1/13/99)

Use AAFs and/or Bid Work Progress Forms	IVCWs are no longer accepted
Use the Bid Verification Form and the Work Progress Form for any work that was bid (especially CAP Implementation). Use an AAF for work in the same phase that was not bid.	If the claim includes activities that were bid, Regional Staff must verify both the necessity and the low bid amount by submitting the necessary forms
Use only one Phase per AAF. Do not re-name any Phase or make any amendments	Note that the verification forms and AAFs now list the specific Phases
Complete the <b>correct</b> AAF for the Phase. Be sure the dates coincide with 1289, 395, and 198 forms.	If the Phase or Reimbursement Period in the claim does not coincide with the correct AAF, the costs will be denied.
Remember: The Release Investigation Phase is valid <b>only</b> for 198 AAFs.	Remember: We did not have a Phase called "Release Investigation" before January 1, 1998.
Check off T040 if you approve it. Do not approve T040 during the CAP Implementation Phase	This task is not eligible for automatic payment. Project management must be approved using Time and Materials for CAP Implementation
If possible, inform OSRR <b>before</b> the Suspense Date if you do not want a claim on the Pending List to be rejected.	Suspense Dates are always on Fridays. Waiting until the end of the Suspense Day to inform OSRR may not provide OSRR with sufficient time to prevent a Rejection.
Make sure the Verification form you use goes <b>with</b> the AAF: "WITH" or "WITH NO" DEQ verification column.	The text of each form describing what your signature means is specific to whether the AAF has a verification column.
Remember to check off (or write in the adjusted number of units and the code) the DEQ verification columns on AAFs.	This is a common oversight. Costs will be denied if each unit is not specifically indicated as verified.
Include all pages of the AAF, even if they are blank. If the RP deliberately did not send DEQ all pages with consecutive Task Numbers, please number the pages you do submit.	Sometimes, a page can get misplaced. If pages are out of order or the number of pages is not included, there is a delay in processing the claim until all pages are obtained.
Complete the Release Report Date.	Costs incurred more than 24 hours prior to the Release report date are automatically denied. This is a mandatory field in our database.
Print your name, SIGN, and date the Verification Form.	Your verification that activities were completed and necessary is a critical financial control for the Fund. To prevent someone else from falsifying a verification form, the Case Manager must sign the form.

## **APPENDIX L**

### **Reserved**

## **APPENDIX M**

### **AAF Verification Forms**



**PETROLEUM CLEAN-UP VERIFICATION**  
**AAFs WITH DEQ Verification Column**

Page 1

Attached is the Activity Authorization for:

Site Name: \_\_\_\_\_ PC#: \_\_\_\_\_ Date Release Reported: \_\_\_\_\_

Phase: Check only one box.

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Release Investigation -198 UCRs only | <input type="checkbox"/> Phase II Initial Abatement      | <input type="checkbox"/> CAP Implementation |
| <input type="checkbox"/> Initial Abatement                    | <input type="checkbox"/> Post Site Characterization Mon. | <input type="checkbox"/> Site Closure       |
| <input type="checkbox"/> Site Characterization                | <input type="checkbox"/> CAP Development                 | <input type="checkbox"/>                    |
| <input type="checkbox"/> Site Characterization Addendum       | <input type="checkbox"/> CAP Addendum                    | <input type="checkbox"/>                    |

Verification: I have reviewed the report for this Phase or Reimbursement Period and the attached AAF. All "Work Performed" units with a check (✓) in the corresponding "DEQ Verified Units" box are verified, eligible, and necessary. Tasks and Materials where the "Work Performed" units could not be verified or are ineligible or were unnecessary are qualified in the corresponding "DEQ Verified Units" box with the correct units and Verification Code.

Verification Codes:     A = ONLY DEQ VERIFIED UNITS WERE NECESSARY  
                              B = ONLY DEQ VERIFIED UNITS WERE ABLE TO BE DOCUMENTED  
                              C = ONLY DEQ VERIFIED UNITS ARE ELIGIBLE FOR REIMBURSEMENT

ADDITIONAL COMMENTS:

---

1. Is this the first occurrence determination for this site? ☐ YES     ☐ NO

If "YES", skip question 2 and complete Parts I, II, and III on Page 2.

If "NO", answer question 2.

2. Is the latest verification information which was previously provided on:

- |  |                              |                             |
|--|------------------------------|-----------------------------|
| a. Part I (number of occurrences) still correct? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| b. Part II (product eligibility) still correct?  | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| c. Part III (negligence) still correct?          | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

If you checked "YES" to a, b, and c do not complete Page 2.

If you checked "NO" to a, b, or c complete the corresponding Part on Page 2.

Page 2 attached: ☐

---

**DEQ Verification**

Printed Name: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

# PETROLEUM CLEAN-UP VERIFICATION

## AAFs **WITH** DEQ Verification Column

Page 2

Site Name: \_\_\_\_\_ PC#: \_\_\_\_\_ DEQ Initials: \_\_\_\_\_

### PART I

Complete the Occurrence Table as follows: (1) under the TANK TYPE heading, check the type of tank(s) which have had releases for this PC # (include all tank types which were reported on previous Worksheets and Verifications); (2) under THE NUMBER OF OCCURRENCES heading, list the number of occurrences in each group from the time of the first release to the present; and (3) provide the TOTAL OCCURRENCES for this PC #.

GROUP	TANK TYPE (check box)	NUMBER OF OCCURRENCES
1	Petroleum Regulated USTs <input type="checkbox"/>	
	Excluded USTs <input type="checkbox"/>	
	Deferred USTs <input type="checkbox"/>	
	Partially Deferred USTs <input type="checkbox"/>	
2	Exempt UST 1(home/farm motor fuel ≤ 1100 gal.) <input type="checkbox"/>	
	Exempt UST 2(home heating oil) <input type="checkbox"/>	
	Small Heating Oil AST <input type="checkbox"/>	
3	Regulated AST Facility <input type="checkbox"/>	
	Unregulated AST Facility <input type="checkbox"/>	
TOTAL OCCURRENCES for this PC #		

### PART II

Are there "Work Performed" activities on this AAF which are the result of any of the following?

1. An UST which contained a non-petroleum substance. ☐ YES ☐ NO
2. An AST which contained a non-free product. ☐ YES ☐ NO

### PART III

Did the release result from one of the following potentially negligent actions?

1. Product pumped into a monitoring well? ☐ YES ☐ NO
2. Product pumped into a fill pipe not connected to a tank? ☐ YES ☐ NO
3. Damage to a line or a tank during excavation or construction activities? ☐ YES ☐ NO
4. Other potential negligent actions? Specify below: ☐ YES ☐ NO

**Instructions for Completing "AAFs WITH DEQ Verification Column"**  
(Use this form for verifying 1289, 395, and 198 AAFs with the DEQ verification column.)

**Page 1**

Fill in the Site Name, PC #, and the Date the Release was Reported.  
Check the box for the appropriate Phase - check only one.

Answer question 1 on Page 1.

If you checked "YES" to question 1, do not answer question 2 and complete Parts I, II, and III on Page 2.

If you checked "NO" to question 1, answer questions 2a, b, and c on Page 1.

If you checked "YES" to questions 2a, b, and c, do not complete Page 2.

For each "NO" you checked to questions 2a, b, or c, complete the corresponding Part on Page 2.

If you completed and attached Page 2, check the box indicating you have attached Page 2.

**AAF Review**

Evaluate the "Work Performed" units submitted by the Responsible Person/Consultant on the AAF(s) to determine if the "Work Performed" units are eligible for reimbursement (based on the Ineligible Activities list in Attachment 1), were necessary, and can be verified.

For each Task or Material where you identify "Work Performed" units which are ineligible for reimbursement (as listed in Attachment 1), reduce the number of units you verify to exclude the ineligible units. Enter only the number of verifiable units that are eligible and necessary and enter Code C (ONLY DEQ VERIFIED UNITS ARE ELIGIBLE) in the corresponding "DEQ Verification" box. PLEASE NOTE: If ineligible "Work Performed" units are also unnecessary and/or not verifiable disapprove the units because the activity is ineligible and use only Code C.

For each Task or Material where you are unable to verify that the "Work Performed" units were performed, reduce the number of units you verify to exclude these units. Enter only the number of verifiable units that are eligible and necessary and enter Code B (ONLY DEQ VERIFIED UNITS WERE ABLE TO BE DOCUMENTED) in the corresponding "DEQ Verification" box.

For each Task or Material where you identified "Work Performed" units which are unnecessary, reduce the number of units you verify to exclude these units. Enter only the number of verifiable units that are eligible and necessary and enter Code A (ONLY DEQ VERIFIED UNITS WERE NECESSARY) in the corresponding "DEQ Verification" box. PLEASE NOTE: If you are disapproving "Work Performed" units for a Task or Material which exceed the authorized amount ("Proposed" plus "Contingent"), the Reimbursement Decision Summary will deny these units because the work was not pre-approved.

For each Task or Material where you agree that all the "Work Performed" units listed are verifiable, eligible and necessary, put a check (✓) in the corresponding "DEQ Verification" box. Placing a check in the DEQ Verification box indicates you are verifying that all the work was performed, eligible, and necessary for that Task or Material. PLEASE NOTE: For each Task or Material where you approving all the "Work Performed" units that exceed the authorized units ("Proposed" plus "Contingent"), you only need to use a check (✓) to indicate that the units are verifiable, eligible, and necessary.

**Page 2**

Fill in the Site Name, PC #, and your initials.

**PART I**

Complete Part I, following the directions on the form.

**PART II & PART III**

Answer all the questions in both Parts. If you answered "YES" to any question in Part II, do not verify the ineligible units on the AAF. If you answered "YES" to any question in Part III, do not verify the negligent units on the AAF.

**Signature**

When you have completed your review, print your name, sign, and date the form on the bottom of Page 1.

## ATTACHMENT 1 - INELIGIBLE REIMBURSEMENT ACTIVITIES FOR REGIONAL AAF REVIEW

1. AST Facility Ground Water Characterization Studies required by 9 VAC 25-90-10, et seq.;
2. Installation of an AST leak detection method required by 9 VAC 25-90-10, et seq.;
3. Testing AST and lines to confirm a leak;
4. AST closure (dismantling or demolition);
5. UST closure (removal or filling in place ) unless part of Interim Authorization or approved Corrective Action Plan;
6. Any corrective action performed more than 24 hours prior to reporting a release to the Regional Office of DEQ;
7. The cost of environmental audits arising from purchase agreements (i.e., Phase I and Phase II assessments for property transfers);
8. Any corrective action costs if the owner/operator is a federal government entity;
9. Attorney's Fees
10. The cost of upgrading, retro-fitting, repairing or replacing a petroleum UST system or AST;
11. The cost for loss or replacement of product;
12. The cost to reinstall electrical wiring, dispensers, pumps, canopies or other items;
13. The cost to replace/repair damage to structures or appliances caused by the release which do not directly represent a risk to human health or the environment. This exclusion does not apply to repairs necessitated by the installation of remediation equipment or repairs to the remediation equipment;
14. The cost for demolition, removal, or relocation of structures or appliances;
15. The cost of concrete and blacktop patching or other improvements beyond that which was removed to remediate the site;
16. The cost of landscaping, replacing trees, shrubs, and sod due to excavation activities or to stress caused by contamination;
17. Costs associated with, but not necessary for, the cleanup of a release from a petroleum storage tank;
18. Extra costs which arise out of restrictions the owner/operator places on how site activities are performed;
19. The cost for calibration of field/testing equipment;
20. Duplicate site management costs and supervisory costs;
21. The cost of air fare, train fare, bus fare, cab fare, or other means of public transportation; or mileage more than 200 miles each way;
22. The cost of express mail or courier services for correspondence, reports or other documents;
23. The cost of ancillary charges, (refer to Volume 1, Section 2.4.2 of the Reimbursement manual for additional information on ancillary costs);
24. Costs incurred solely for business purposes and which are not necessary for corrective action;
25. The cost of overtime for professional staff.
26. Costs to repair or replace structures or landscape elements that were moved, damaged, or destroyed as a result of conducting release response and corrective action at the site.

PETROLEUM CLEAN-UP VERIFICATION  
395 AAFs **WITH NO** DEQ Verification Column

Page 1

Attached is the Activity Authorization for:

Site Name: \_\_\_\_\_ PC#: \_\_\_\_\_ Date Release Reported: \_\_\_\_\_

Phase: Check only one box.

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Initial Abatement              | <input type="checkbox"/> Phase II Initial Abatement      | <input type="checkbox"/> CAP Addendum       |
| <input type="checkbox"/> Site Characterization          | <input type="checkbox"/> Post Site Characterization Mon. | <input type="checkbox"/> CAP Implementation |
| <input type="checkbox"/> Site Characterization Addendum | <input type="checkbox"/> CAP Development                 | <input type="checkbox"/> Site Closure       |

Verification: I have reviewed the report for this Phase or Reimbursement Period and the attached AAF. All "Work Performed" units not listed in the Qualification Table were authorized and are verified, eligible, and necessary. Tasks and Materials where the "Work Performed" units exceed the authorized units, or could not be verified, or are ineligible, or were unnecessary are listed in the Qualification Table on Page 2 with the correct units and Verification Codes.

ADDITIONAL COMMENTS:

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1. Is this the first occurrence determination for this site? ☐ YES ☐ NO

If "YES", skip question 2 and complete Parts I, II, and III on Page 3.

If "NO", answer question 2.

2. Is the latest verification information which was previously provided on:
- |  |                              |                             |
|--|------------------------------|-----------------------------|
| a. Part I (number of occurrences) still correct? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| b. Part II (product eligibility) still correct?  | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| c. Part III (negligence) still correct?          | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

If you checked "YES" to a, b, and c do not complete Page 3.

If you checked "NO" to a, b, or c complete the corresponding Part on Page 3.

Pages attached: ☐ Page 2 ☐ Page 3

**DEQ Verification**

Printed Name: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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## Page 2

DEQ Initials:

[illegible]

Effective: 1/1/98  
Revised 5/1/98

# PETROLEUM CLEAN-UP VERIFICATION

## 395 AAFs **WITH NO** DEQ Verification Column

Site Name: \_\_\_\_\_ PC#: \_\_\_\_\_ DEQ Initials: \_\_\_\_\_

### PART I

Complete the Occurrence Table as follows: (1) under the TANK TYPE heading, check the type of tank(s) which have had releases for this PC # (include all tank types which were reported on previous Worksheets and Verifications); (2) under THE NUMBER OF OCCURRENCES heading, list the number of occurrences in each group from the time of the first release to the present; and (3) provide the TOTAL OCCURRENCES for this PC #.

GROUP	TANK TYPE (check box)	NUMBER OF OCCURRENCES
1	Petroleum Regulated USTs <input style="float: right;" type="checkbox"/>	
	Excluded USTs <input style="float: right;" type="checkbox"/>	
	Deferred USTs <input style="float: right;" type="checkbox"/>	
	Partially Deferred USTs <input style="float: right;" type="checkbox"/>	
2	Exempt UST 1 (home/farm motor fuel ≤ 1100 gal.) <input style="float: right;" type="checkbox"/>	
	Exempt UST 2 (home heating oil) <input style="float: right;" type="checkbox"/>	
	Small Heating Oil AST <input style="float: right;" type="checkbox"/>	
3	Regulated AST <input style="float: right;" type="checkbox"/>	
	Unregulated AST Facility <input style="float: right;" type="checkbox"/>	
TOTAL OCCURRENCES for this PC#		

### PART II

Are there "Work Performed" activities on this AAF which are the result of any of the following?

1. An UST which contained a non-petroleum substance. ☐ YES ☐ NO
2. An AST which contained a non-free product. ☐ YES ☐ NO

### PART III

Did the release result from one of the following potentially negligent actions?

1. Product pumped into a monitoring well? ☐ YES ☐ NO
2. Product pumped into a fill pipe not connected to a tank? ☐ YES ☐ NO
3. Damage to a line or a tank during excavation or construction activities? ☐ YES ☐ NO
4. Other potential negligent actions? Specify below: ☐ YES ☐ NO

**Instructions for Completing "AAFs WITH NO DEQ Verification Column"**  
(Only use this form for verifying 395 AAFs **WITH NO** DEQ verification column.)

**Page 1**

Fill in the Site Name, PC #, and the Date the Release was Reported.  
Check the box for the appropriate Phase - check only one.

Answer question 1 on Page 1.

If you checked "YES" to question 1, do not answer question 2 and complete Parts I, II, and III on Page 3.

If you checked "NO" to question 1, answer questions 2a, b, and c on Page 1.

If you checked "YES" to questions 2a, b, and c, do not complete Page 3.

For each "NO" you checked to questions 2a, b, or c, complete the corresponding Part on Page 3.

Pages Attached: check the box(es) indicating the pages you have attached.

**PAGE 2**

Evaluate the "Work Performed" units submitted by the Responsible Person/Consultant on the AAF(s) to determine if the "Work Performed" units are eligible for reimbursement (based on the Ineligible Activities list in Attachment 1), were necessary, and can be verified.

1. Identify Tasks and Materials where "Work Performed" units do not exceed "Proposed" plus "Contingent" units and you agree that all the "Work Performed" units are verifiable, eligible, and necessary. For each of these Tasks and Materials, your signature on this form verifies these units. PLEASE NOTE: Do not complete the Qualification Table on Page 2 for these Tasks and Materials.
2. Complete the Qualification Table on Page 2 for each Task and Material where "Work Performed" units are ineligible, or could not be verified, or were unnecessary, or exceed the authorized units as follows:
  - a. Write the Task or Material Code for the item and enter the "Work Performed" units listed on the AAF by the claimant.
  - b. For each Task or Material where you identify "Work Performed" units which are ineligible for reimbursement (as listed in Attachment 1), reduce the number of units you verify to exclude the ineligible units. Enter only the number of verifiable units that are eligible and necessary and enter Code C (ONLY DEQ VERIFIED UNITS ARE ELIGIBLE). PLEASE NOTE: If ineligible "Work Performed" units are also unnecessary and/or not verifiable, disapprove the units because the activity is ineligible and use only Code C.
  - c. For each Task or Material where you are unable to verify that the "Work Performed" units were performed, reduce the number of units you verify to exclude these units. Enter only the number of verifiable units that are eligible and necessary and enter Code B (ONLY DEQ VERIFIED UNITS WERE ABLE TO BE DOCUMENTED).
  - d. For each Task or Material where you identified "Work Performed" units which are unnecessary, reduce the number of units you verify to exclude these units. Enter only the number of verifiable units that are eligible and necessary and enter Code A (ONLY DEQ VERIFIED UNITS WERE NECESSARY).
  - e. For each Task or Material where you identified "Work Performed" units which exceed the authorized amount ("Proposed" plus "Contingent"), enter only the number of verifiable units that are eligible and necessary and enter Code A (ONLY DEQ VERIFIED UNITS WERE NECESSARY) PLEASE NOTE: If you are disapproving "Work Performed" units for a Task or Material which exceed the authorized amount (proposed plus contingent), the Reimbursement Decision Summary will deny these units because the work was not pre-approved.

If more than one Page 2 is necessary, number the pages in sequential order starting with 2a (e.g., 2a, 2b, 2c,...).



**Page 3**

Fill in the Site Name, PC #, and your initials.

***PART I***

Complete Part I, following the directions on the form.

***PART II & PART III***

Answer all the questions in both Parts. If you answered "YES" to any question in Part II, do not verify the ineligible units on the AAF.

If you answered "YES" to any question in Part III, do not verify the negligent units on the AAF.

**Signature**

When you have completed your review, print your name, sign, and date the form on the bottom of Page 1.

## ATTACHMENT 1.- INELIGIBLE REIMBURSEMENT ACTIVITIES FOR REGIONAL AAF REVIEW.

1. AST Facility Ground Water Characterization Studies required by 9 VAC 25-90-10, et seq.;
2. Installation of an AST leak detection method required by 9 VAC 25-90-10, et seq.;
3. Testing AST and lines to confirm a leak;
4. AST closure (dismantling or demolition);
5. UST closure (removal or filling in place ) unless part of Interim Authorization or approved Corrective Action Plan;
6. Any corrective action performed more than 24 hours prior to reporting a release to the Regional Office of DEQ;
7. The cost of environmental audits arising from purchase agreements (i.e., Phase I and Phase II assessments for property transfers);
8. Any corrective action costs if the owner/operator is a federal government entity;
9. Attorney's Fees
10. The cost of upgrading, retro-fitting, repairing or replacing a petroleum UST system or AST;
11. The cost for loss or replacement of product;
12. The cost to reinstall electrical wiring, dispensers, pumps, canopies or other items;
13. The cost to replace/repair damage to structures or appliances caused by the release which do not directly represent a risk to human health or the environment. This exclusion does not apply to repairs necessitated by the installation of remediation equipment or repairs to the remediation equipment;
14. The cost for demolition, removal, or relocation of structures or appliances;
15. The cost of concrete and blacktop patching or other improvements beyond that which was removed to remediate the site;
16. The cost of landscaping, replacing trees, shrubs, and sod due to excavation activities or to stress caused by contamination;
17. Costs associated with, but not necessary for, the cleanup of a release from a petroleum storage tank;
18. Extra costs which arise out of restrictions the owner/operator places on how site activities are performed;
19. The cost for calibration of field/testing equipment;
20. Duplicate site management costs and supervisory costs;
21. The cost of air fare, train fare, bus fare, cab fare, or other means of public transportation; or mileage more than 200 miles each way;
22. The cost of express mail or courier services for correspondence, reports or other documents;
23. The cost of ancillary charges, (refer to Volume 1, Section 2.4.2 of the Reimbursement manual for additional information on ancillary costs);
24. Costs incurred solely for business purposes and which are not necessary for corrective action;
25. The cost of overtime for professional staff.
26. Costs to repair or replace structures or landscape elements that were moved, damaged, or destroyed as a result of conducting release response and corrective action at the site.

**PETROLEUM CLEAN-UP VERIFICATION OF AAFs**  
**Category 1 & Category 2 SMALL HEATING OIL TANKS**

Attached is the Activity Authorization for:

Site Name: \_\_\_\_\_ PC#: \_\_\_\_\_ Date Release Reported: \_\_\_\_\_

Check appropriate category, tank type and phase. List the number of occurrences on EACH AAF.

**Category:**      \_\_\_ Category 1                      **Tank Type:**      \_\_\_ Small Heating Oil UST

                         \_\_\_ Category 2    \_\_\_ Small Heating Oil AST

**No. of Occurrences**      \_\_\_\_\_

**Phase:**      \_\_\_ Site Characterization    \_\_\_ Post SCR Monitoring

                         \_\_\_ Site Characterization Addendum    \_\_\_ Closure (well)

---

Verification: I have reviewed the report for this Phase or Reimbursement Period and the attached AAF. All "Work Performed" units with a check (✓) in the corresponding "DEQ Verified Units" box are verified, eligible, and necessary. Tasks and Materials where the "Work Performed" units could not be verified or are ineligible or were unnecessary are qualified in the corresponding "DEQ Verified Units" box with the correct units and Verification Code.

Verification Codes:      A = ONLY DEQ VERIFIED UNITS WERE NECESSARY  
                                    B = ONLY DEQ VERIFIED UNITS WERE ABLE TO BE DOCUMENTED  
                                    C = ONLY DEQ VERIFIED UNITS ARE ELIGIBLE FOR REIMBURSEMENT

ADDITIONAL COMMENTS:

---

Did the release result from one of the following potentially negligent actions?

- |   |                              |                             |
|---|------------------------------|-----------------------------|
| 1. Product pumped into a monitoring well?                                   | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| 2. Product pumped into a fill pipe not connected to a tank?                 | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| 3. Damage to a line or a tank during excavation or construction activities? | <input type="checkbox"/> YES | <input type="checkbox"/> NO |
| 4. Other potential negligent actions? Specify below:                        | <input type="checkbox"/> YES | <input type="checkbox"/> NO |

COMMENTS

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**DEQ Verification:**

Printed Name: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Effective: 8/21/01

## **APPENDIX N**

### **Bidding Corrective Action Implementation**

Current electronic copies of the Bid Comparison, Bid Summary, Bid Work Progress, and Bid Cost Worksheets are maintained by the Storage Tank Program as part of the Virginia Petroleum Storage Tank Fund Reimbursement Guidance Manual. The Reimbursement Manual may be downloaded from the DEQ web page at:

[www.DEQ.state.va.us](http://www.DEQ.state.va.us)

From the deq home page, select "Petroleum Programs" from the topics on the left side of the screen. On the Petroleum Programs web page, select "Download Library." Next, select "Reimbursement Files - Manuals/UCRS" and download Volumes I and II of the Reimbursement Guidance Manual

# BID VERIFICATION FORM

Attached is the Bid Progress Form for:

PC Number: \_\_\_\_\_ Site Name: \_\_\_\_\_ Date Release Reported \_\_\_\_\_

Region: \_\_\_\_\_ Reimbursement Period: From \_\_\_\_\_ to \_\_\_\_\_

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Release Investigation          | <input type="checkbox"/> Phase II Initial Abatement      | <input type="checkbox"/> CAP Implementation |
| <input type="checkbox"/> Initial Abatement              | <input type="checkbox"/> Post Site Characterization Mon. | <input type="checkbox"/> Site Closure       |
| <input type="checkbox"/> Site Characterization          | <input type="checkbox"/> CAP Development                 |   |
| <input type="checkbox"/> Site Characterization Addendum | <input type="checkbox"/> CAP Addendum                    |   |

I have reviewed the Bid Work Progress Form for the Reimbursement Period listed above. The Total Amount of Low Bid is correct and based on my knowledge of the site, it appears the scope of work and total percentage completed corresponds with the actual work performed except as discussed below.

List and describe the all discrepancies between work performed at the site and the total percentage complete claimed during this reimbursement period. You must:

1. Indicate below, the correct Amount of Total Low Bid
2. Indicate below, a revised Percentage of Work Completed for all discrepancies and
3. Indicate below, any work performed that was not pre-approved.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

How was this information verified?

Field Visit (Dates) \_\_\_\_\_

Reports \_\_\_\_\_

DEQ Regional Office Verification:

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## **APPENDIX O**

### **Ground Water Models: Basic Equations and Typical Input Parameters**

## Appendix O. Ground Water Models: Basic Equations and Typical Input Parameters

During the Site Characterization process, staff must often review predictions made from transport and fate models. This appendix provides some of the basic equations that are used in many transport and fate models. Also discussed are input parameters that are frequently required. Where possible or appropriate, ranges of values for individual parameters have been provided. It is important to note that although ranges of "typical" values are provided for many parameters, site specific conditions may be atypical and fall outside of the expected range.

Mathematically, the simplest transport and fate model involves one-dimensional flow. The one dimensional model is a conservative approach because it assumes that hydrocarbon transport is concentrated along a narrow path toward the receptor and that ground water flow is directly toward the receptor. The model assumes zero lateral dispersion resulting in a maximum hydrocarbon concentration at the receptor. One dimensional transport can be represented by the following equation (Freeze and Cherry 1979):

$$dC_i/dt = 1/RC (D_1 C \ d^2C_i/d_1^2 - V_1C \ dC_i/d_1) \quad (1)$$

where

- $C_i$  = concentration of constituent i dissolved in ground water (mg/l)
- $t$  = time
- $D_1$  = hydrodynamic dispersion coefficient (cm<sup>2</sup>/sec)
- $V_1$  = average interstitial pore-water velocity (cm/sec)
- $R$  = Retardation factor (dimensionless).

### Dispersion

The hydrodynamic dispersion coefficient in equation 1 is composed of mechanical dispersion and molecular diffusion and may be calculated by the equation:

$$D_1 = \alpha_l V + D^* \quad (\text{Lyman et al 1992}) \quad (2)$$

where

- $\alpha_l$  = longitudinal dispersivity of the medium (cm)
- $D^*$  = molecular diffusion coefficient
- $V$  = average linear ground water velocity (cm/sec)

At high flow velocities, mechanical mixing is the dominant dispersive process and molecular diffusion contributes relatively little to the overall hydrodynamic dispersion within a system. According to Tucker and Nelken (1982), molecular diffusion can probably be ignored when determining hydrodynamic dispersion if pore water velocities exceed .002 cm/second. Mechanical dispersivity is dependent upon grain size distribution but independent of grain shape. According to Lyman et al (1992), dispersivity values that are measured in the field are usually greater than those measured in the laboratory and typically range from .01 to 2 centimeters.

Molecular diffusion is a process whereby constituents move from areas of high concentration to low concentration under the influence of their kinetic activity. Diffusion is independent of advection within the medium and will occur as long as a concentration gradient exists. Accordingly, molecular diffusion becomes an important contributor to the overall dispersion process when flow rates are low (Freeze and Cherry 1979). Diffusion may be calculated from the following equation:

$$D^* = \tau D \quad (\text{Lyman et al 1992}) \quad (3)$$

where

$D$  = diffusion coefficient ( $\text{cm}^2/\text{sec}$ )  
 $\tau$  = tortuosity factor ( $0 < \tau < 1$ ) (dimensionless)

According to Millington and Quirk (1961), tortuosity is a function of porosity and may be estimated by:

$$\tau = \theta^{1.33} \quad (4)$$

where

$\theta$  = soil porosity (dimensionless) (See Table R-3)

Tortuosity usually ranges from .01 to .5 (Tucker and Nelken 1981)

Most organic chemicals, especially neutral ones of low molecular weight, diffuse at about the same rate in water (Lyman et al 1992). Diffusion rates also decrease with decreasing temperature. Typical diffusion values for organic chemicals in water range from  $10^{-4}$  to  $10^{-5} \text{ cm}^2/\text{sec}$ . (Witherspoon and Bonoli 1969).



## Retardation

The retardation factor represents the transport rate of a given constituent relative to ground water flow. Retardation is dependent upon the chemical characteristics of the constituent and, for non-polar organic compounds such as BTEX, the organic carbon content,  $f_{oc}$ , of the aquifer. Retardation may be represented by the equation:

$$R = V_w/V_i = 1 + K_d (\rho_d/\theta) \quad (\text{Lyman et al 1992}) \quad (5)$$

where

$V_w$  = average velocity of ground water (cm/sec)  
 $V_i$  = average velocity of contaminant i in ground water (cm/sec)  
 $K_d$  = sorption coefficient (cm<sup>3</sup>/sec)  
 $\rho_d$  = soil bulk density (g/cm<sup>3</sup>) (See Table R-2)  
 $\theta$  = soil porosity (dimensionless) (See Table R-3)

The sorption coefficient for a constituent may be determined by a variety of methods which are discussed further in Table R-4. One of the more common techniques for deriving the sorption coefficient is provided in equation 6 below:

$$K_d = K_{oc} C f_{oc} \quad (\text{Lyman et al 1992}) \quad (6)$$

where

$K_{oc}$  = sorption coefficient normalized for organic carbon  
 $f_{oc}$  = weight fraction of organic carbon in the soil (%)

The soil organic matter content is one of the key variables affecting the retardation of organic constituents in ground water. According to Lyman et al (1992), soil carbon content may span 2 orders of magnitude. In the saturated zone, most soils are expected to have a carbon content of less than .1 percent (Newsom 1985). It is highly recommended that the fraction of organic carbon value used in transport and fate models be specific to the individual site.

The sorption coefficient normalized for organic carbon ( $K_{oc}$ ) may also be derived by any of several methods. Table R-1 lists values for  $K_{oc}$  that were taken from the Superfund Public Health Evaluation Manuals (EPA 1986). The  $K_{oc}$  value may also be estimated from the following equations:

$$\log K_{oc} = .779 \log K_{ow} + .46 \quad (\text{Arthur D. Little, Inc. 1987}) \quad (7)$$

$$\log K_{oc} = -.602 \log S + .656 \quad (\text{Arthur D. Little, Inc. 1987}) \quad (8)$$

where

$S$  = water solubility of the constituent (moles/L)  
 $K_{ow}$  = octanol/water partition coefficient (dimensionless)

It is generally believed that for hydrophobic compounds, the relationships based on the octanol/water partition coefficient are superior to those based on water solubility (Lyman et al 1992). Solubility based relationships are probably superior to those based on the octanol/water partition coefficient for gasoline constituents that have low  $K_{ow}$  values.

Table O-1. Chemical Properties of Selected Petroleum Constituents

Compound	Solubility (mg/L)	Mol. wt. g/mol	Henry's constant cm <sup>3</sup> /cm <sup>3</sup>	Octanol/Water Partition Coeff. log K <sub>ow</sub> (L/kg)	Organic Carbon Adsorption Coeff. log K <sub>oc</sub> (L/kg)	Reported Degradation Rates (day <sup>-1</sup> )
benzene	1780 <sup>1</sup>	78.11	2.25e-1	1.58 <sup>2</sup>	2.13 <sup>2</sup>	.007 <sup>8</sup> .0085 <sup>9</sup> .095 <sup>10</sup> .007 - .0024 <sup>11</sup>
toluene	537 <sup>1</sup>	92.13	2.74e-1	2.13 <sup>2</sup>	2.65 <sup>2</sup>	.011 <sup>8</sup> .067 <sup>11</sup> .025 - .099 <sup>12</sup>
ethylbenzene	167 <sup>1</sup>	106.2	3.58e-1	1.98 <sup>2</sup>	3.13 <sup>2</sup>	.003 - .116 <sup>12</sup>
Xylenes	198 <sup>2</sup>	106.2	2.95e-1	2.38 <sup>2</sup>	3.26 <sup>2</sup>	.004 - .014 <sup>11</sup> .019 - .0495 <sup>12</sup>
MTBE	4.8 x 10 <sup>4</sup> <sup>3</sup>	88.15	2.2e-2	1.08 <sup>5</sup>	1.06 - 1.30 <sup>7</sup>	.0019 - .0866 <sup>12</sup>
Pyrene	.132 <sup>2</sup>	202.3	3.71e-4	4.58 <sup>2</sup>	4.88 <sup>2</sup>	
benzo(a)pyrene	.00120 <sup>2</sup>	252.3	1.86e-5	5.59 <sup>2</sup>	5.98 <sup>2</sup>	.0007 - .0061 <sup>12</sup>
phenanthrene	1.00 <sup>2</sup>	178.21	1.31e-3	4.15 <sup>2</sup>	4.46 <sup>2</sup>	
Naphthalene	31.0 <sup>4</sup>	128.19	1.74e-2	3.11 <sup>6</sup>	3.28 <sup>4</sup>	.0027 <sup>12</sup>

<sup>1</sup> Lyman, W.L. 1987. "Environmental Partitioning of Gasoline in Soil/Groundwater Compartments." Final Seminar Proceedings on Underground Environment of an UST Motor Fuel Release. USEPA RREL, sponsors, Edison, N.J.

<sup>2</sup> USEPA. 1986. Superfund Public Health Evaluation Manuals. NTIS No. PB87-183125.

<sup>3</sup> CHEM-BANK, Hazardous Chemical Databank on Compact Disk -- HSDB. U.S. National Library of Medicine.

<sup>4</sup> Verschueren, K., 1983. Handbook of Environmental Data on Organic Chemicals, 2nd Edition. Van Nostrand Reinhold Co., Inc., New York, NY.

<sup>5</sup> Dragun, J. 1988. The Soil Chemistry of Hazardous Materials. Hazardous Materials Control Research Institute, Silver Spring, Md.

<sup>6</sup> Lyman, W.J., W.F. Reehl and D.H. Rosenblatt. 1982. Handbook of Chemical Property Estimation Methods. McGraw Hill, New York, NY.

<sup>7</sup> CRCS Inc. 1986. Information Review Tert-Butyl Methyl Ether. EPA Contract No. 68-01-6650.

<sup>8</sup> Barker, J.F., G.C. Patrick and D. Major. 1987. "Natural Attenuation of Aromatic Hydrocarbons in a Shallow Sand Aquifer." Ground Water Monitoring Review. Volume 7, pp. 64-71.

<sup>9</sup> Kemblowski, M.W., J.P. Salanitro, G.M. Deeley and C.C. Stanley. 1987. "Fate and Transport of Residual Hydrocarbons in Ground Water: A Case Study." Proceedings of the Petroleum Hydrocarbons and Organic Chemicals in Ground Water Conference. National Well Water Association and American Petroleum Institute, Houston, Tx. Pp. 207 - 231.

<sup>10</sup> Chiang, C.Y., J.P. Salanitro, E.Y. Chou, J.D. Colthart and C.L. Klein. 1989. "Aerobic Biodegradation of Benzene, Toluene, Ethylbenzene, and Xylene in a Sandy Aquifer - Data Analysis and Computer Modeling." Ground Water. Volume 27, No. 6. pp. 823-834.

<sup>11</sup> Wilson, B.H., J.T. Wilson, D.H. Kampbell, B.E. Bledsoe and J.M. Armstrong. 1991. "Biotransformation of Monoaromatic and Chlorinated Hydrocarbons at an Aviation Gasoline Spill Site." Geomicrobiology Journal. Volume 8. pp. 225 - 240.

<sup>12</sup> Howard, P., et al. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers Inc., Chelsea, Michigan.

Table O-2. Selected Values for Soil Bulk Density	
Soil Type	Bulk Density (g/cm <sup>3</sup> )
Surface soils found in agricultural areas: well decomposed organic soil cultivated surface mineral soil clay, clay loam, silt loam sands and sandy loam	.2 - .3 1.25 - 1.4 1.0 - 1.6 1.2 - 1.8
Materials used in road and airfield construction silts and clays sand and sandy soils gravel and gravelly soils	1.3 - 2.0 1.6 - 2.2 1.8 - 2.3
Very compact subsoils	up to 2.5
Source: Donigian, A.S. Jr., T.Y.R. Lo and E.W. Shanahan. 1984. <u>Groundwater Contamination and Emergency Response Guide, Part III</u> . Noyes Publications, Park Ridge, NJ.	

Table O-3. Range of Porosity	
Material Type	Porosity Range (%)
Gravel	25 - 40
Sand	25 - 50
Silt	35 - 50
Clay	40 - 70
Fractured Basalt	5 - 50
Karst Limestone	5 - 50
Sandstone	5 - 30
Limestone, Dolomite	0 - 20
Shale	0 - 10
Fractured Crystalline Rock	0 - 10
Dense Crystalline Rock	0 - 10
Source: Freeze, R.A. and J.A. Cherry. 1979. <u>Groundwater</u> . Prentice-Hall Inc., Englewood Cliffs, NJ.	

Table O-4. Summary of advantages and disadvantages of methods used to determine the sorption coefficient.		
Method	Advantages	Disadvantages
Correlation Equations	The only analytical requirement is $f_{oc}$	Theoretically based but essentially empirical
$K_{ow}$ and S	Relatively simple  Inexpensive  Minimal equipment requirements  Give results that are internally consistent and reasonably consistent with other methods	No assurance equation applicable to a particular soil  Do not account for sorption in mineral phase. May be important in fine grained soils.  Different equations and different parameter values are available and the best choice is not always clear.  Accurate measurements of $f_{oc}$ are difficult in soils that have a low carbon content.
Lab batch	Provide a direct measure for the particular soil and organic compound.  Applicability of $K_d$ can be assessed on the basis of isotherm linearity.  Can be used to evaluate the effects of factors such as changing competition for sorption sites.	The lab tests require specialized equipment and skilled, experienced staff due to volatility and sorption onto many labware materials.  The analytical equipment needed is relatively expensive.  The $K_d$ values are applicable to static conditions.
Lab column	Provides a $K_d$ value that is appropriate for dynamic conditions.  Small losses of the constituent due to volatilization should not affect results significantly as the $K_d$ values are calculated from the relative times of arrival.  The velocity sensitivity of $K_d$ may be evaluated.	Specialized and expensive equipment is required.  Time consuming and, therefore, costly.  Apparent mass loss and asymmetry remain as technical uncertainties.  Inconvenient for soils with low hydraulic conductivity and very high $K_d$ values
Field column	The field column has advantages and disadvantages similar to the laboratory column. In addition, it ensures that the measurement is made under natural geochemical conditions. On the other hand, being performed in the field, the tests are most costly and the least convenient of those considered.	
Source: Superfund University Training Institute. 1996. <u>Transport and Fate of Contaminants in the Subsurface</u> .		

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## **APPENDIX P**

### **Equations for Quantifying Risks to Receptors**

## Equations for Quantifying Risks to Receptors

General information for performing a quantitative risk assessment is presented below. The equations and other information presented were derived from the following sources:

EPA Region III. April 1996. Risk Based Concentration Table.

EPA. 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Interim Final.

The equations and accompanying input parameters listed below are intended to provide staff with a tool that they may use to evaluate risks at a site. Conservative default values are provided for many of the input parameters and may be used when deemed appropriate and/or when site specific information is not available. Although the equations and input parameters listed below deal with residential exposure, the equations are valid for commercial or industrial exposures provided that the input parameters are modified to represent a workplace exposure.

Please note that these equations are not meant as the only approach that staff and others may use to evaluate risks. In all instances, the regional Case Manager has the authority to determine the most appropriate means by which to evaluate the site.

### Residential Exposure: Ingestion of chemicals in drinking water

$$\begin{array}{lcl} \text{Carcinogenic Constituents} & & \text{CPSo} * \text{CW} * \text{EF} * \text{IRWadj} \\ \text{Excess lifetime cancer risk} & = & \text{-----} \\ \text{(Unitless)} & & \text{ATc} \end{array}$$

$$\begin{array}{lcl} \text{Non-carcinogenic Constituents} & & \text{CW} * \text{IRWc} * \text{EF} * \text{EDc} \\ \text{Hazard Quotient} & = & \text{-----} \\ \text{(unitless)} & & \text{RfDo} * \text{BWc} * \text{ATn} \end{array}$$

NOTE: Ingestion rate, exposure duration, and body weight for a child should be used as a conservative assumption unless site-specific conditions make this assumption inappropriate.

Variable Descriptions:

CW	=	Concentration of constituent in Water (mg/liter).
IRW	=	Ingestion Rate (liters/day).
IRWa	=	ingestion rate for an adult (2 liters/day)
IRWc	=	ingestion rate for a child ages 1-6 (1 liter/day)
IRWadj	=	ingestion rate, adjusted for age (see calculation below)



# Ingestion of chemicals in drinking water continued

EF	=	Exposure Frequency (350 days/year)
ED	=	Exposure Duration (years)
EDa	=	exposure duration, adult (use 30 years for adult exposure only and 24 years if adult exposure is combined with childhood exposure at same residence)
EDc	=	exposure duration, child (6 years)
BW	=	Body Weight (kilograms)
BWa	=	body weight for an adult (70kg)
BWc	=	body weight for a child (15 kg)
AT	=	Averaging Time (period over which exposure is averaged -- Days)
ATn	=	Averaging time for noncarcinogens (ED * 365 days/year)
ATc	=	Averaging time for carcinogens (25550 days; this is a 70 year lifetime multiplied by 365 days/year)
CPSo	=	carcinogenic potency slope, oral (kg * day/mg)
RfDo	=	reference dose, oral (mg/kg/day)

Adjusted ingestion rate is the integrated exposure rate from birth to age 30. This adjusted rate accounts for differences in contact rates, body weights, and exposure durations for two age groups - small children (ages 1-6) and adults.

$$\begin{aligned}
 \text{IRWadj} &= \frac{(\text{EDc} * \text{IRWc})}{\text{BWc}} + \frac{(\text{EDa} * \text{IRWa})}{\text{BWa}} \\
 \text{IRWadj} &= \frac{(6 \text{ years} * 1 \text{ l/day})}{15 \text{ kg}} + \frac{(24 \text{ years} * 2 \text{ l/day})}{70 \text{ kg}} \\
 \text{IRWadj} &= 1.09
 \end{aligned}$$

### Residential exposure: Ingestion of chemicals in surface water while swimming

$$\begin{array}{l} \text{Carcinogenic Constituents} \\ \text{Excess lifetime cancer risk} \\ \text{(Unitless)} \end{array} = \frac{\text{CPSo} * \text{CW} * \text{CRc} * \text{EF} * \text{ET} * \text{CRWadj}}{\text{ATc}}$$

$$\begin{array}{l} \text{Non-carcinogenic Constituents} \\ \text{Hazard Quotient} \\ \text{(unitless)} \end{array} = \frac{\text{CW} * \text{EF} * \text{CRWc} * \text{EDc} * \text{ET}}{\text{RfDo} * \text{BWc} * \text{ATn}}$$

#### Variable Descriptions:

CW	=	Concentration of constituent in Water (mg/liter).
CRW	=	Contact Rate (ml/hour)
CRWa	=	Contact Rate, adult (consult literature or Central Office for appropriate input values)
CRWc	=	Contact Rate, child
CRWadj	=	Contact Rate, adjusted (see equation below)
EF	=	Exposure Frequency (7 days/year is the national average)
ET	=	Exposure time (hours/event)
ED	=	Exposure Duration (years)
EDa	=	exposure duration, adult (use 30 years for adult exposure only and 24 years if combined with childhood exposure at same residence)
EDc	=	exposure duration, child (6 years)
BW	=	Body Weight (kilograms)
BWa	=	body weight for an adult (70kg)
BWc	=	body weight for a child (15 kg)
AT	=	Averaging Time (period over which exposure is averaged -- Days)
ATn	=	averaging time, noncarcinogens (ED * 365 days/year)
ATc	=	averaging time, carcinogens (25550 days; this is a 70 year lifetime multiplied by 365 days/year)
CPSo	=	carcinogenic potency slope, oral (kg * day/mg)
RfDo	=	reference dose, oral (mg/kg/day)

Adjusted contact rate is the integrated exposure rate from birth to age 30. This adjusted rate accounts for differences in contact rates, body weights, and exposure durations for two age groups - small children (ages 1-6) and adults.

$$\text{CRWadj} = \frac{(\text{EDc} * \text{CRWc})}{\text{BWc}} + \frac{(\text{EDa} * \text{CRWa})}{\text{BWa}}$$

## Residential Exposure: Ingestion of chemicals in soil

$$\begin{array}{lcl} \text{Carcinogenic Constituents} & & \text{CPSo} * \text{CS} * \text{FI} * \text{EF} * \text{CF} * \text{IRSadj} \\ \text{Excess lifetime cancer risk} & = & \text{-----} \\ \text{(Unitless)} & & \text{ATc} \end{array}$$

$$\begin{array}{lcl} \text{Non-carcinogenic Constituents} & & \text{CS} * \text{IRS} * \text{EF} * \text{FI} * \text{EDc} * \text{CF} \\ \text{Hazard Quotient} & = & \text{-----} \\ \text{(unitless)} & & \text{RfDo} * \text{BWc} * \text{ATn} \end{array}$$

### Variable Descriptions:

CS	=	Concentration of constituent in soil (mg/kg).
CF	=	conversion factor (10 <sup>-6</sup> kg/mg)
FI	=	Fraction ingested from contaminated soil (unitless) (use 1 for residential exposure and .5 for commercial or industrial exposure)
IRS	=	Ingestion Rate (mg/day)
IRSa	=	ingestion rate for an adult (100 mg/day)
IRSc	=	ingestion rate for a child (200 mg/day)
IRSadj	=	ingestion rate, adjusted (see equation below)
EF	=	Exposure Frequency (350 days/year)
ED	=	Exposure Duration (years)
EDa	=	exposure duration, adult (30 years for adult exposure only and 24 years if combined with childhood exposure at same residence)
EDc	=	exposure duration, child (6 years maximum)
BW	=	Body Weight (kilograms)
BWa	=	body weight for an adult (70kg)
BWc	=	body weight for a child (15 kg)
AT	=	Averaging Time (period over which exposure is averaged -- Days)
ATn	=	averaging time, noncarcinogens (AT = ED * 365 days/year)
ATc	=	averaging time, carcinogens (25550 days; this is a 70 year lifetime multiplied by 365 days/year)
CPSo	=	carcinogenic potency slope, oral (kg * day/mg)
RfDo	=	reference dose, oral (mg/kg/day)

Residential Exposure: Ingestion of chemicals in soil continued.

Adjusted ingestion rate accounts for differences in contact rates, body weights, and exposure durations for two age groups - small children (ages 1-6) and adults.

$$\text{IRS}_{\text{adj}} = \frac{(\text{ED}_{\text{c}} * \text{IRSc})}{\text{BW}_{\text{c}}} + \frac{(\text{ED}_{\text{a}} * \text{IRSa})}{\text{BW}_{\text{a}}}$$

## Residential Exposure: Inhalation of airborne (vapor phase) chemicals

$$\begin{array}{lcl} \text{Carcinogenic Constituents} & & \text{CPSi} * \text{CA} * \text{EF} * \text{ET} * \text{IRAadj} \\ \text{Excess lifetime cancer risk} & = & \text{-----} \\ \text{(Unitless)} & & \text{ATc} \end{array}$$

$$\begin{array}{lcl} \text{Non-carcinogenic Constituents} & & \text{CA} * \text{IRAc} * \text{EF} * \text{EDc} * \text{ET} \\ \text{Hazard Quotient} & = & \text{-----} \\ \text{(unitless)} & & \text{RfDi} * \text{BWc} * \text{ATn} \end{array}$$

### Variable Descriptions:

CA	=	Concentration of constituent in air (mg/cubic meter).
IRA	=	Inhalation Rate (cubic meters/day).
IRAA	=	inhalation rate for an adult (20 cubic meters/day)
IRAc	=	inhalation rate for a child (12 cubic meters/day)
IRAadj	=	inhalation rate, adjusted (see equation below)
EF	=	Exposure Frequency (350 days/year)
ET	=	Exposure time (The fraction of the day that the receptor is exposed to the constituent via this pathway). For example, if the receptor is exposed for one hour each day, the exposure time is 1/24 or .042). A default value of 1 is recommended unless site specific information indicates that the receptor is exposed for less than 24 hours each day.
ED	=	Exposure Duration (years)
EDa	=	exposure duration, adult (30 years for adult exposure only and 24 years if combined with childhood exposure at same residence)
EDc	=	exposure duration, child (6 years)
BW	=	Body Weight (kilograms)
BWa	=	body weight for an adult (70kg)
BWc	=	body weight for a child (15 kg)
AT	=	Averaging Time (period over which exposure is averaged -- Days)
ATn	=	averaging time, noncarcinogens (AT = ED * 365 days/year)
ATc	=	averaging time, carcinogens (25550 days, this is a 70 year lifetime multiplied by 365 days/year)
CPSi	=	carcinogenic potency slope, inhalation (kg * day/mg)
RfDi	=	reference dose, inhalation (mg/kg/day)

Residential Exposure: Inhalation of airborne (vapor phase) chemicals continued

Adjusted inhalation rate accounts for differences in inhalation rates, body weights, and exposure durations for two age groups - small children (ages 1-6) and adults.

$$IR_{Aadj} = \frac{(ED_c * IR_{Ac})}{BW_c} + \frac{(ED_a * IR_{Aa})}{BW_a}$$

### Residential Exposure: Inhalation of volatile constituents from water

$$\begin{array}{lcl} \text{Carcinogenic Constituents} & & \text{CPSi} * \text{CW} * \text{EF} * \text{ET} * \text{K} * \text{IRAadj} \\ \text{Excess lifetime cancer risk} & = & \text{-----} \\ \text{(Unitless)} & & \text{ATc} \end{array}$$

$$\begin{array}{lcl} \text{Non-carcinogenic Constituents} & & \text{CW} * \text{IRAc} * \text{EF} * \text{ET} * \text{EDc} * \text{K} \\ \text{Hazard Quotient} & = & \text{-----} \\ \text{(unitless)} & & \text{RfDi} * \text{BWc} * \text{ATn} \end{array}$$

#### Variable Descriptions:

CW	=	Concentration of constituent in water (mg/l).
IRA	=	Inhalation Rate (cubic meters/day).
IRAA	=	inhalation rate for an adult (20 cubic meters/day)
IRAc	=	inhalation rate for a child (12 cubic meters/day)
IRAadj	=	inhalation rate, adjusted (see equation below)
EF	=	Exposure Frequency (350 days/year)
ET	=	Exposure time (The fraction of the day that the receptor is exposed to the constituent via this pathway). For example, if the receptor is exposed for one hour each day, the exposure time is 1/24 or .042). A default value of 1 is recommended unless site specific information indicates that the receptor is exposed for less than 24 hours each day.
K	=	Volatilization factor (L/cubic meter)
ED	=	Exposure Duration (years)
EDa	=	exposure duration, adult (30 years for adult exposure only and 24 years if combined with childhood exposure at same residence)
EDc	=	exposure duration, child (6 years maximum)
BW	=	Body Weight (kilograms)
BWa	=	body weight for an adult (70kg)
BWc	=	body weight for a child (15 kg)
AT	=	Averaging Time (period over which exposure is averaged -- Days)
ATn	=	averaging time, noncarcinogens (AT = ED * 365 days/year)
ATc	=	averaging time, carcinogens (25550 days, this is a 70 year lifetime multiplied by 365 days/year)
CPSi	=	carcinogenic potency slope, inhalation (kg * day/mg)
RfDi	=	reference dose, inhalation (mg/kg/day)

Residential Exposure: Inhalation of volatile constituents from water continued

$$IRA_{adj} = \frac{(ED_c * IRA_c)}{BW_c} + \frac{(ED_a * IRA_a)}{BW_a}$$



## Residential Exposure: Inhalation of particulates

$$\begin{array}{lcl} \text{Carcinogenic Constituents} & & \text{CPSi} * C * EF * (1/PEF) * ET * I\text{R}_{\text{adj}} \\ \text{Excess lifetime cancer risk} & = & \text{-----} \\ \text{(Unitless)} & & \text{ATc} \end{array}$$

$$\begin{array}{lcl} \text{Non-carcinogenic Constituents} & & C * I\text{Rc} * EF * E\text{Dc} * ET * (1/PEF) \\ \text{Hazard Quotient} & = & \text{-----} \\ \text{(unitless)} & & \text{RfDi} * B\text{Wc} * \text{ATn} \end{array}$$

### Variable Descriptions:

C	=	Concentration of constituent in the particulates (mg/cubic meter).
IR	=	Inhalation Rate (cubic meters/day).
IRa	=	inhalation rate for an adult (20 cubic meters/day)
IRc	=	inhalation rate for a child (12 cubic meters/day)
IRadj	=	inhalation rate, adjusted (see equation below)
EF	=	Exposure Frequency (350 days/year)
ED	=	Exposure Duration (years)
EDa	=	exposure duration, adult (30 years for adult exposure only and 24 years if combined with childhood exposure at same residence)
EDc	=	exposure duration, child (6 years maximum)
ET	=	Exposure time (The fraction of the day that the receptor is exposed to the constituent via this pathway). For example, if the receptor is exposed for one hour each day, the exposure time is 1/24 or .042). A default value of 1 is recommended unless site specific information indicates that the receptor is exposed for less than 24 hours each day.
PEF	=	particulate emission factor (use a value of 4.63 x 10 <sup>9</sup> cubic meters/kg for both residential and industrial exposures)
BW	=	Body Weight (kilograms)
BWa	=	body weight for an adult (70kg)
BWc	=	body weight for a child (15 kg)
AT	=	Averaging Time (period over which exposure is averaged -- Days)
ATn	=	averaging time, noncarcinogens, AT = ED * 365 days/year
ATc	=	averaging time, carcinogens (25550 days; this is a 70 year lifetime multiplied by 365 days/year)
CPSi	=	carcinogenic potency slope, inhalation (kg * day/mg)
RfDi	=	reference dose, inhalation (mg/kg/day)

Residential Exposure: Inhalation of particulates continued

$$IR_{adj} = \frac{(ED_c * IR_c)}{BW_c} + \frac{(ED_a * IR_a)}{BW_a}$$

## Residential exposure: Dermal contact with chemicals in water

$$\text{Carcinogenic Constituents excess lifetime cancer risk} = \frac{\text{CPSo} * \text{CW} * \text{PC} * \text{EF} * \text{CF} * \text{ET} * \text{SAadj}}{\text{ATc}}$$

$$\text{Non-carcinogenic Constituents Hazard quotient} = \frac{\text{CW} * \text{SAc} * \text{EDc} * \text{PC} * \text{EF} * \text{CF} * \text{ET}}{\text{RfDo} * \text{BWc} * \text{ATn}}$$

### Variable descriptions:

CW	=	Chemical concentration in water (mg/l)
SA	=	Skin surface area available for contact (sq. cm)
SAa	=	skin surface area, adult (18000 sq. cm)
SAc	=	skin surface area, child (7500 sq.cm)
SAadj	=	adjusted dermal contact rate (see equation below)
PC	=	Chemical specific dermal permeability constant (cm/hr)
EF	=	Exposure Frequency (350 days/year)
ED	=	Exposure Duration (years)
EDa	=	exposure duration, adult (30 years for adult exposure only and 24 years if combined with childhood exposure at same residence)
EDc	=	exposure duration, child (6 years maximum)
ET	=	Exposure time (hours/day). For showering, use an exposure time of .12 hours/day.
CF	=	Volumetric conversion factor for water (1 liter/1000 cubic cm)
BW	=	Body Weight (kilograms)
BWa	=	body weight for an adult (70kg)
BWc	=	body weight for a child (15 kg)
AT	=	Averaging Time (period over which exposure is averaged -- Days)
ATn	=	averaging time, noncarcinogens (AT = ED * 365 days/year)
ATc	=	averaging time, carcinogens (25550 days; this is a 70 year lifetime multiplied by 365 days/year)
CPSo	=	carcinogenic potency slope, oral (kg * day/mg)
RfDo	=	reference dose, oral (mg/kg/day)

Residential Exposure: Dermal contact with chemicals in water continued

Adjusted dermal contact rate accounts for differences in skin surface area, body weights, and exposure durations for two age groups - small children (ages 1-6) and adults.

$$SA_{adj} = \frac{(ED_c * SA_c)}{BW_c} + \frac{(ED_a * SA_a)}{BW_a}$$

## Residential Exposure: Dermal contact with chemicals in soil

$$\text{Carcinogenic Constituents excess lifetime cancer risk} = \frac{\text{CPSo} * \text{CS} * \text{EF} * \text{CF} * \text{ABS} * \text{AF} * \text{SAadj}}{\text{ATc}}$$

$$\text{Non-carcinogenic Constituents Hazard quotient} = \frac{\text{CS} * \text{SAc} * \text{EDc} * \text{ABS} * \text{EF} * \text{CF} * \text{AF}}{\text{RfDo} * \text{BWc} * \text{ATn}}$$

AF = soil to skin adherence factor. (1.45 mg/sq. cm for commercial potting soil)  
(2.77 mg/sq. cm for kaolin clay)

ABS = absorption factor (unitless)  
Staff may use values from literature or the following:  
VOCs 10 to 25 %  
Semi-volatiles 1 to 10%

CS = Chemical concentration in soil (mg/kg)

CF = conversion factor ( $10^{-6}$  kg/mg)

SA = Skin surface area available for contact (sq. cm)

SAa = skin surface area, adult (18000 sq. cm)

SAc = skin surface area, child (7500 sq.cm)

SAadj = adjusted dermal contact rate (see equation below)

EF = Exposure Frequency (350 days/year)

ED = Exposure Duration (years)

EDa = exposure duration, adult (30 years for adult exposure only and 24 years if combined with childhood exposure at same residence)

EDc = exposure duration, child (6 years maximum)

BW = Body Weight (kilograms)

BWa = body weight for an adult (70 kg)

BWc = body weight for a child (15 kg)

AT = Averaging Time (period over which exposure is averaged -- Days)

ATn = averaging time, noncarcinogens (ED \* 365 days/year)

ATc = averaging time, carcinogens (25550 days; this is a 70 year lifetime multiplied by 365 days/year)

CPSo = carcinogenic potency slope, oral (kg \* day/mg)

Residential Exposure: Dermal contact with chemicals in soil continued.

RfDo = reference dose, oral (mg/kg/day)

$$SA_{adj} = \frac{(ED_c * SA_c)}{BW_c} + \frac{(ED_a * SA_a)}{BW_a}$$

Excess lifetime cancer risks for individual carcinogens may not exceed one in one million. Risks from exposure to a particular constituent should be calculated across all appropriate pathways of exposure.

$$\text{Total Cancer Risk}_{\text{constituent x}} = \text{Risk}_{\text{oral}} + \text{Risk}_{\text{inhalation}} + \text{Risk}_{\text{dermal}}$$

For non-carcinogens, the hazard index shall not exceed a value of one for multiple constituents. The hazard index may be calculated by using the following equations:

$$\text{Hazard Quotient}_{\text{constituent x}} = \text{Risk}_{\text{oral}} + \text{Risk}_{\text{inhalation}} + \text{Risk}_{\text{dermal}}$$

$$\text{Hazard Index} = \text{Hazard Quotient}_{\text{constituent x}} + \text{Hazard Quotient}_{\text{constituent y}} + \dots + \text{Hazard Quotient}_{\text{constituent i}}$$

## **APPENDIX Q**

### **Reserved**



## **APPENDIX R**

### **Discharges to Surface Water**

## Discharges to Surface Water

Information contained within this Appendix is intended to provide guidance to staff when evaluating discharges to surface water via baseflow. The procedures discussed below were derived from DEQ guidance memoranda (Numbers 00-2011 and 93-021) that are provided to the Water Permits staff for use in the VPDES program and the Fact Sheet for the General VPDES Permit for Petroleum Contaminated Sites. Although discharges via baseflow may be physically different than point source discharges, these procedures are believed to be applicable to many of the surface water discharge situations that staff will encounter. In all cases, the regional Case Manager has the ultimate authority regarding the methods that are most appropriate to evaluate conditions at each site and may use the procedures discussed below at his/her discretion.

When evaluating discharges to surface water, Storage Tank Program staff should be aware that in stream chronic and acute standards for aquatic life and humans were established to protect receiving stream uses from point source discharges. A primary assumption that was made when these standards were established was that the stream would be dry when effluent was discharged to the stream (i.e. a dry ditch discharge). These standards are, therefore, based upon a conservative assumption that constituents discharged to surface water will not be diluted by the receiving stream.

## Aquatic Toxicity of Petroleum Constituents

### *Benzene*

The EPA criteria document for benzene (EPA 440/5-80-018) states that acute toxicity by freshwater organisms exposed to benzene has been observed and documented at concentrations as low as 5,300 µg/l (micrograms per liter; this is the LC50<sup>R-1</sup> for rainbow trout). The document also states that acute toxicity would occur at lower concentrations for more sensitive species. This LC50 value for rainbow trout was divided by 10 in order to approximate a level which would not be expected to cause acute toxicity. The acute toxicity concentration that DEQ will use for benzene in freshwater, in the absence of more specific information about sensitive species at the site, is 530 µg/l.

NOTE: A safety factor of 10 percent of the LC50 concentration is recommended by the National Academy of Sciences for establishing acute toxicity guidelines or limits and this approach is generally used in the absence of more detailed data about species that are particularly sensitive to the constituent of concern.

The determination of chronic toxicity is generally based on the application of a 10 percent factor to the “safe” acute toxicity concentration for a constituent. The chronic toxicity concentration that the DEQ Storage Tank Program will use for benzene in freshwater (in the absence of more specific information about sensitive species) is 53 µg/l.

R-1      The LC50 is the concentration of a substance that is lethal to fifty percent of the population that is exposed to that substance

The EPA criteria document for benzene indicates that stress and survival effects occur at concentrations as low as 700 µg/l when saltwater species are exposed to benzene for long periods. After a 10 percent safety factor is applied to this chronic effect concentration, the chronic standard for benzene discharged to saltwater would be 70 µg/l.

#### *Toluene*

The EPA criteria document for toluene (EPA 440/5-80-075) states that acute toxicity to freshwater organisms from exposure to toluene occurs at a concentration of 17,500 µg/l. Application of the safety factors of 10 and 100 yields acute and chronic toxicity limits for toluene in freshwater of 1,750 µg/l and 175 µg/l, respectively.

Observed chronic effects of toluene on saltwater organisms reportedly occur at concentrations as low as 5000 µg/l. Applying a safety factor of 10 to this chronic concentration yields a chronic toxicity limit of 500 µg/l for toluene in saltwater.

#### *Ethylbenzene*

The EPA criteria document for ethylbenzene (EPA 440/5-80-048) provides an acute, LC50 concentration of 32,000 µg/l for bluegill sunfish. In accordance with the guidelines used for the above constituents, this LC50 concentration is divided by 10 to establish a “safe” acute toxicity limit for ethylbenzene in freshwater of 3200 µg/l. The “safe” acute toxicity limit is then divided by a safety factor of 10 to provide a chronic toxicity limit for ethylbenzene in freshwater of 320 µg/l.

The EPA criteria document for ethylbenzene indicates that saltwater species may experience acute toxic effects from exposure to concentrations of ethylbenzene as low as 430 µg/l. Applying the safety factors of 10 and 100 yields acute and chronic toxicity concentrations of 43 µg/l and 4.3 µg/l, respectively.

#### *Xylenes*

Xylenes are not listed as priority pollutants in Section 307(b) of the Clean Water Act, therefore, no criteria document exists for these isomers. DEQ staff that developed the VPDES General Permit for Petroleum Contaminated Sites searched EPA’s AQUIRE database and found that the lowest freshwater LC50 reported for xylenes is 8,200 µg/l. The staff then applied the safety factors of 10 and 100 to this LC50 concentration and derived acute and chronic limits for xylenes in freshwater of 820 µg/l and 82 µg/l, respectively.

A review of EPA’s AQUIRE database by DEQ staff indicated that the lowest LC50 concentration for xylenes in saltwater was 7,400 µg/l. After applying the standard safety factors, the acute and chronic limits for xylenes in saltwater are 740 µg/l and 74 µg/l, respectively.

#### *Naphthalene*

The EPA criteria document for naphthalene (EPA 440/5-80-059) indicates that the chronic toxicity level for exposure to naphthalene by fathead minnows is 620 µg/l. The document states that chronic effects would occur at lower concentrations if more sensitive species were exposed. The acute and chronic limits for naphthalene in

freshwater are 620 µg/l and 62, respectively.

The lowest LC50 value in the criteria document for exposure of saltwater species to naphthalene is 2350 µg/l for grass shrimp. After applying the appropriate safety factors, the acute and chronic limits for naphthalene in saltwater are 235 µg/l and 23.5 µg/l, respectively.

<b>Table R-1. In-stream standards (µg/l)</b>				
Parameter	Freshwater acute	Freshwater chronic	Saltwater acute	Saltwater chronic
Benzene	530	53	700	70
Toluene	1750	175	5000	500
Ethylbenzene	3200	320	43	4.3
Xylenes	820	82	740	74
Naphthalene	620	62	235	23.5

## Discharges to Free Flowing Streams

A method developed by the DEQ Division of Water Permit Coordination to determine discharge limits for permits in the Virginia Pollution Discharge Elimination System program is an example of a procedure that regional staff may use to determine maximum allowable petroleum concentrations in ground water discharging to surface water. Assumptions made in the following procedure include:

1. The stream has a rectangular channel of constant cross section that is much wider than it is deep.
2. The effluent is entering at the side of a free flowing stream via a point source (pipe, channel, or ditch).
3. The transport of materials by longitudinal mixing is very small compared with transport by advection.
4. Complete vertical mixing occurs instantaneously.
5. The effluent is neutrally buoyant.
6. Acute and chronic exposure times for passing and drifting aquatic organisms are one hour and two days, respectively. Passing organisms are assumed to have a mean velocity that is greater than or equal to mean stream velocity. Drifting organisms are assumed to have a mean velocity equal to stream velocity.

Contaminants entering surface water as a result of baseflow are obviously not entering at the side of a stream from a point source. In most instances, this assumption violation is not believed to be critical as the delivery rate of constituents into surface water will usually be much lower for baseflow than it is for a continuous source. This assumption violation may be of concern when a free flowing stream is intercepted by a large contaminant plume that extends over a significant length of the stream. If the width of the plume intercepting the stream is ten percent or more of the length of stream over which water would flow in one hour (the distance that is considered for acute toxicity), this method should not be used unless it is modified.

The assumption of a neutrally buoyant effluent may or may not be met. Ground water containing low concentrations of petroleum constituents (concentrations in the parts per million magnitude or less) probably will have a density similar to that of the receiving water. Ground water containing an immiscible fluid may have a significantly different average density than surface water. The discharge of free product to surface water is

unacceptable regardless of contaminant concentration and the derivation of waste load allocations under such situations is believed to be of little use.

The first consideration to make when determining waste load allocations for a discharge is the level of antidegradation protection that applies to the particular surface water body. All state waters are provided one of three levels of antidegradation protection. At a minimum, all waters are subject to a base level of protection known as "tier 1" or existing use protection. Tier 1 waters are defined as those waters where one or more standards (except fecal coliform) are not being maintained or are barely being met. In these tier 1 waters, existing uses of the water and water quality to protect those uses must be maintained. The assignment of waters to a tier 1 designation must be made on the basis of documented information. Waters are not assigned to tier 1 on a default basis.

Water bodies having better quality than the standards for each parameter are referred to as "tier 2" or high quality waters. Water quality within tier 2 waters may not be significantly lowered without an evaluation of the economic and social impact. Waters should be assigned to the tier 2 designation in the absence of contrary documentable evidence.

Water bodies in the third level of protection (tier 3) are designated by regulatory amendment to the standards as exceptional waters on the basis of environmental setting, aquatic communities, or recreational opportunities. New or increased discharges of constituents to Tier 3 waters are not allowed and discharges of petroleum or regulated substance into Tier 3 streams should be prevented. On April 30, 1997, North Creek (Botetourt County) was designated a Tier 3 stream. North Creek is presently (as of the effective date of this manual) the only stream designated to Tier 3 within the Commonwealth. Water bodies receiving a tier 3 designation at future dates may be found in 9 VAC 25-260-30.C.

After the water body has been classified based upon ambient water quality, a waste load allocation may be developed. Waste load allocations for tier 1 waters are calculated so that all standards applying to the water under consideration are maintained. Waste load allocations for tier 2 waters are calculated so that reductions in the quality of the receiving stream will be limited to no more than 25 percent (10 percent for human health parameters) of the difference between the existing quality and the quality allowed by the standards. For example, if constituent "AB" has an existing in stream concentration (i.e. background) which is below detection limits and the standard for that constituent is 10 ug/l, the maximum capacity that can be allocated for that parameter that may be considered insignificant is:

$$0.25 (10 \text{ ug/l} - 0 \text{ ug/l}) = 2.5 \text{ ug/l.}$$

$$25\%(\text{surface water standard for constituent} - \text{background concentration of constituent})$$

This becomes the stream standard for application of antidegradation and is used to calculate waste load allocations. Additional degradation is not allowed by current or future discharges.

Once the antidegradation baseline has been established, a waste load allocation may be calculated by:

$$WLA = \frac{\{Std (Qs (f) + Qd)\} - (Qs (f) Cs)}{Qd}$$

Where:

WLA = waste load allocation

Std = the stream standard (mg/l)

Qs = stream flow (l/sec)

Qd = effluent flow (l/sec)

Cs = background concentration of constituent in surface water (mg/l)

f = decimal fraction of low flow to use

Stream flows that must be considered when determining waste load allocations (WLA) are the 7Q10 flow for chronic toxicity and the 1Q10 flow for acute toxicity. WLA should be determined based upon the more restrictive (lower) value for acute and chronic toxicity as indicated in Examples R-1 and R-2. Stream flow information is available through the DEQ Division of Water Permit Coordination. The fraction of low flow to use (f) is a function of stream and effluent flow, stream slope and width, and roughness and meandering of the stream bed. The Division of Water Permit Coordination has developed a program to calculate the fraction of low flow to use. This program is part of Guidance Memorandum 00-2011 and is available in the "Water Quality Guidance" section of DEQ's web page. Input parameters needed for the program are:

name of the discharger

7Q10 stream flow (MGD)

1Q10 stream flow (MGD)

effluent flow (MGD)

stream slope (ft/ft)

stream width (ft)

a number representing the roughness of the stream bed (options provided in program)

a number representing the degree of meandering (options provided in program)

### Example R-1. Discharge to a free flowing stream

Polecat Creek is a Tier 2 stream with a 7Q10 flow of 10 gal/sec (37.85 l/sec, .864 MGD) and a 1Q10 flow of 8.68 gal/sec (.75 MGD). The background benzene concentration in Polecat Creek is below the detection limit. Ground water velocity is 25 ft/year and the contaminant plume in ground water discharging to surface water is 100 feet wide and 20 feet thick. Porosity in the saturated zone is thirty percent. Contaminant plume discharge is as follows:

$$\begin{aligned} Q_d &= 25 \text{ ft/yr} \times 100 \text{ ft} \times 20 \text{ ft} \times .30 \\ Q_d &= 15,000 \text{ cubic ft/yr} \\ Q_d &= 15,000 \text{ cubic ft/yr} / (60 \text{ sec} \times 60 \text{ min} \times 24 \text{ hours} \times 365 \text{ days}) \\ Q_d &= 4.8 \times 10^{-4} \text{ cubic ft/sec} \\ Q_d &= 4.8 \times 10^{-4} \text{ cubic ft/sec} \times 2.832 \times 10 \\ Q_d &= .0136 \text{ l/sec} (3.1 \times 10^{-4} \text{ MGD}) \end{aligned}$$

The stream gradient is .0004 ft/ft and the stream width is 10 feet. The mixing equation developed by the Division of Water Permit Coordination indicates that a complete mix assumption is appropriate for both the 7Q10 and 1Q10 flow at this example site and a complete mix may be assumed for both the chronic WLA and the acute WLA. The in stream chronic standard for benzene is .053 mg/l. The chronic WLA for benzene is calculated as follows:

$$\begin{aligned} \text{Std} &= .25(.053 \text{ mg/l} - 0 \text{ mg/l}) \\ \text{Std} &= .013 \text{ mg/l} \end{aligned}$$

$$\text{WLA} = \frac{.013 \text{ mg/l} (37.854 \text{ l/sec} (1) + .0136 \text{ l/sec}) - (37.854 \text{ l/sec} (1) (0 \text{ mg/l}))}{.0136 \text{ l/sec}}$$

$$\text{WLA} = \frac{.492 \text{ mg/sec}}{.0136 \text{ l/sec}}$$

$$\text{WLA} = 36.17 \text{ mg/l}$$

The contaminant plume discharging to surface water may contain a benzene concentration of up to 36 mg/l.

Note: The stream flow rates used in this example may not be realistic from the perspective of water budget within a drainage basin. The purpose of this example is to show staff how to calculate a waste load allocation for constituents that are being discharged into surface water.

### Example R-2. Discharge to a free flowing stream

Raccoon Run is a Tier 2 stream having a 7Q10 discharge of 1 l/sec (.023 MGD) and a 1Q10 discharge of .35 l/sec (.008 MGD). The background concentration of benzene in Raccoon Run is below the detection limit. The contaminant plume intercepting the stream is 100 feet wide and 20 feet thick. Ground water velocity is 25 feet per year. Porosity in the saturated zone is 30 percent. The annual ground water discharge contributed by the plume is 15,000 cubic feet per year (.0136 liters/second,  $3.1 \times 10^{-4}$  MGD).

The stream gradient is .0004 ft/ft and the stream width is 10 feet. The mixing equation developed by the Division of Water Permit Coordination indicates that a complete mix may be assumed when determining the chronic waste load allocation. A complete mix may not be assumed for determining the acute WLA and the program indicates that only 6.24 percent of the 1Q10 flow should be used when calculating the acute WLA.

$$\begin{aligned}\text{Std (chronic)} &= .25 (.053 \text{ mg/l} - 0 \text{ mg/l}) \\ &= .013 \text{ mg/l}\end{aligned}$$

$$\begin{aligned}\text{Std (acute)} &= .25 (.530 \text{ mg/l} - 0 \text{ mg/l}) \\ &= .13 \text{ mg/l}\end{aligned}$$

$$\text{WLA (chronic)} = \frac{.013 \text{ mg/l} [ 1 \text{ l/sec} (1) + .0136 \text{ l/sec} ] - (1 \text{ l/sec}) (1) (1 \text{ mg/l})}{.0136 \text{ l/sec}}$$

$$= \frac{.0132 \text{ mg/sec}}{.0136 \text{ mg/l}}$$

$$= .96 \text{ mg/l}$$

$$\text{WLA (acute)} = \frac{.136 \text{ mg/l} [ (.35 \text{ l/sec} (.0624) + .0136) ] - (.35 \text{ l/sec}) (.0624) (0 \text{ mg/l})}{.0136 \text{ mg/l}}$$

$$= \frac{.00482 \text{ mg/sec}}{.0136 \text{ mg/l}}$$

$$= .354 \text{ mg/l}$$

In this situation, the acute waste load allocation for benzene is the limiting factor for the discharge. The contaminant plume may, at the point of discharge, have a benzene concentration of up to .354 mg/l.

Note: The stream flow rates used in this example may not be realistic from the perspective of water budget within a drainage basin. The purpose of this example is to show staff how to calculate a waste load allocation for constituents that are being discharged into surface water.



### **Discharges to tidal waters**

Generalized concepts may be successfully applied to discharges to free flowing streams because a set of simplifying assumptions (listed in the previous section) may often be made about physical processes operating in these situations. Discharges to tidal waters, however, may have distinctly different mixing processes depending upon the physical environment and do not readily lend themselves to a relatively simple set of generalizations. Staff may consider a 50:1 dilution ratio for the chronic waste load allocation. It is recommended that the acute waste load allocation be set equal to the acute water quality standard and that staff apply the acute standards at the point where ground water discharges to surface water. If regional staff or the responsible person believe that this is too limiting or not appropriate for a specific case, additional work may be performed to better define dominant mixing processes and the behavior of free swimming and drifting organisms in the area of the discharge. This information may then be used to derive a more site specific waste load allocation.

### **Discharges to lakes, swamps, and marshes**

Mixing in standing surface water is usually limited and depends primarily upon concentration gradients and turbulence caused by wind. The complete mixing of incoming constituents, therefore, may occur over an extended period of time and violate exposure times for aquatic organisms. Unless the tank owner or operator is able to demonstrate acceptable conditions, it is recommended that the water quality standards be applied at the point or along the interface where ground water discharges to surface water.

## **APPENDIX S**

### **Public Notice**

PUBLIC NOTICE

PROPOSAL TO CLEANUP  
AN UNDERGROUND STORAGE TANK (UST) SITE

There has been a release from an underground storage tank system at:

**(name of facility)**  
**(location of facility)**

The Department of Environmental Quality (DEQ) is requiring **(name of responsible person)** to develop a Corrective Action Plan to address cleanup of **(type of contamination)** at the site. If you have any questions regarding the cleanup, please contact:

**(name, address and telephone number of the responsible person contact.)**

The Corrective Action Plan will be submitted to the \_\_\_\_\_ Regional Office of the DEQ on **(insert date)**. If you would like to review or discuss the proposed Corrective Action Plan with the staff of the DEQ, please feel free to contact **(insert regional contact person and phone number)** after the date of the Corrective Action Plan submittal. The DEQ \_\_\_\_\_ Regional Office will consider written comments regarding the proposed Corrective Action Plan until **(insert a date that is at least 30 days after the CAP due date)** and may decide to hold a public meeting if there is significant public interest. Written comments should be sent to the DEQ at the address listed below. The DEQ requests that all written comments reference the tracking number for this case; PC # \_\_\_\_\_.

Department of Environmental Quality  
Storage Tank Program  
**Regional Office Address**

**NOTE:**        **The responsible person must confirm the regional contact person, that person's phone number, and the deadline for submitting comments on the proposed corrective action with the Regional Office prior to initiating public notice.**

(4-25-97)

## **APPENDIX T**

### **Guidelines for Special Waste Disposal**

# Form SPSW-1

## SPECIAL WASTE DISPOSAL REQUEST PROPOSED RECEIVING FACILITY

### **Section I. Solid Waste Management Facility Identification:**

Facility Name: \_\_\_\_\_

Facility Permit No. \_\_\_\_\_

Facility Location: \_\_\_\_\_

Facility Address: \_\_\_\_\_

\_\_\_\_\_

### **Section II. Request**

I hereby seek a letter of clarification from the Department as to whether this SWMF may receive the special waste described in the attached documents for disposal. The waste is described as follows:

Generator: \_\_\_\_\_

General Description of Waste: \_\_\_\_\_

\_\_\_\_\_

Form SPSW-2 Attached? Yes ( ) No ( )

Form SPSW-3 Attached? Yes ( ) No ( )

Attachments:

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_
- f. \_\_\_\_\_
- g. \_\_\_\_\_
- h. \_\_\_\_\_

**Section III. Facility Compliance Information**

1. Is the facility implementing a groundwater monitoring program in accordance with VSWMR Part V?

( ) N/A ( ) Yes ( ) No

2. Has the facility evaluated the groundwater data and submitted any required notifications and the required reports?

( ) N/A ( ) Yes ( ) No

3. Is the cell in which the special waste is to be disposed underlain with a synthetic or compacted soil liner with a hydraulic conductivity of no more than  $1 \times 10^{-7}$  cm per second?

( ) N/A ( ) Yes ( ) No

4. Is the cell in which the special waste is to be disposed underlain with a leachate collection system?

( ) N/A ( ) Yes ( ) No

5. Does the facility have financial assurance as required by the Financial Assurance Regulations of Solid Waste Facilities (VR 672-20-1)?

( ) N/A ( ) Yes ( ) No

6. Is the facility operating within compliance of the VSWMR such that it received an overall rating of at least satisfactory on its most recent Compliance Inspection Report?

( ) N/A ( ) Yes ( ) No

**Note: Non-compliance with any of the above may jeopardize the special waste disposal request.**

#### **Section IV. Waste Stream Verification**

1. Have you examined the information submitted by the generator and determined that the special waste is not prohibited by your permit and/or the VSWMR?

( ) Yes ( ) No

2. Does the facility have as part of its written operational plan, and implement, an active waste analysis program for confirming that the special waste received in conjunction with this request is only the waste as described by the generator?

( ) Yes ( ) No

**Note:** If, after receiving a letter of clarification from the Department which approves the special waste disposal request, a facility determines that the waste it receives does not conform to the information submitted on Form SPSW-2, the SWMF shall reject the waste and notify the generator and the Department of the circumstances of the rejection, including any information that the waste may be a hazardous waste.

## Certification

I am authorized by the Virginia Board for Waste Management Facility Operators (VBWMFO) to act as a waste management facility operator for this Solid Waste Management Facility. I hereby certify that the above information is true and accurate to the best of my knowledge upon diligent inquiry. I request that the Department evaluate the request for disposal of the special waste within this facility.

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

VBWMFO Certification No.: \_\_\_\_\_ Class: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_



# Form SPSW-2

## SPECIAL WASTE DISPOSAL REQUEST GENERATOR INFORMATION

### Section I. Generator Identification:

a. Generator Name: \_\_\_\_\_

b. Generator Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

c. Generator Phone: (     ) \_\_\_\_\_

### Section II. General Waste Profile:

Note: It is the duty of all persons to dispose of their solid waste in a legal manner (Va. Code § 10.1-1418.1.A). In addition, any person who generates a solid waste shall determine if that waste is a hazardous waste (§ 6.1 of the Virginia Hazardous Waste Management Regulations (VR 672-10-1) ("VHWMR")).

a. General description of waste, including its state (e.g., solid liquid, semi-solid, gas):

\_\_\_\_\_

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b. Amount of materials proposed for disposal:

Volume or Weight \_\_\_\_\_

Units \_\_\_\_\_

c. Activities or processes from which the waste was generated, including process flow diagrams specifically addressing the waste stream(s), a description of the source of the waste, and a statement of whether the waste was formerly managed as a hazardous waste.

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NOTE: Attach a flow diagram and indicate any deletions due to proprietary or trade secret information. The Department cannot protect proprietary information or trade secrets.

d. Location of generation:

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e. Method of transportation:

Describe the manner in which the material is being transported for disposal (e.g., bulk containers):

---

---

---

f. Testing results

PARAMETER	ANALYZED (METHOD)	NOT ANALYZED (REASON)	RESULTS INCLUDED (Y) YES (N) NO
Corrosivity			
Ignitability			
Reactivity			
TCLP (a - e) only			
a. Metals			
b. Volatile Organics			
c. Semi Volatile Organics			

d. Pesticides			
e. Herbicides			
Total Metals			
Volatile Organics			
Semi-Volatile Organics			
Pesticides			
Herbicides			
PCBs			
Paint-Filters Test			
Radioactive Waste			
Asbestos			
Percent Solids			
TOX			
TPH			

g. Sample location map included: Yes ( ) No ( )

**Section III. Generator Certification:**

I hereby certify, based upon my diligent inquiry into the activities, materials, and processes generating the materials described on this form:

1. That these materials are not classified as listed or characteristic hazardous waste governed by the Commonwealth of Virginia or the state of origin of this waste;
2. That the materials are not regulated medical waste governed by the Virginia Regulated Medical Waste Management Regulations (VR 672-40-01);
3. That the materials do not contain 50.0 parts per million or more of polychlorinated biphenyls (PCB's);
4. That the materials do not contain more than 1.0 part per billion of dioxins;
5. That the material is not a radioactive waste or possess the property of radioactivity;
6. That the materials are not prohibited or restricted from disposal in a Virginia solid waste management facility; and
7. That the analytical results, completed application and attached documentation submitted in support of this special waste disposal request are a representative, true, and accurate description of these materials.

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Notary Statement

# Form SPSW-3

## SPECIAL WASTE DISPOSAL REQUEST OTHER HANDLER INFORMATION

### Section I. Handler Identification:

- a. Handler Name: \_\_\_\_\_
- b. Handler Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- c. Handler Phone: (     ) \_\_\_\_\_

### Section II. Applicability

- a. This form applies to parties who have handled special solid wastes that are to be disposed in a Virginia solid waste management facility (SWMF), unless the handler does no more than haul the waste directly from the generator to the SWMF without treating the waste or mixing it with other materials, or allowing another party to do so.
- b. Any person who has treated a special solid waste or mixed it with another material must complete a separate Form SPSW-2.

**Section III. Waste Identification:**

This statement is provided for the following waste:

Generator: \_\_\_\_\_

General Description of Waste: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Form SPSW-2 Attached? Yes ( ) No ( )

**Section IV. Handler Management:**

Describe completely your management or your company's management of the waste:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Section V. Handler Certification:**

I hereby certify that:

1. based on my diligent inquiry, the above information is true and complete;
2. based upon my diligent inquiry, the waste described above has not been treated or mixed with any other materials while in my custody; and
3. to my knowledge, the waste described above has not been treated or mixed with any other materials by another party.

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Notary Statement:



## **APPENDIX U**

### **Air Emission Exemption Formulas and Threshold Limit Values for Selected Petroleum Constituents**

## **Air Emission Exemption Formulas and Threshold Limit Values for Selected Petroleum Constituents**

Exemption formulas for toxic pollutants (See 9 VAC 5-80-11):

1. For toxic pollutants with a TLV-C  
$$\text{Exempt emission rate (lbs/hour)} = \text{TLV-C (mg/m}^3\text{)} \times .033$$
2. For toxic pollutants with both a TLV-STEL and a TLV-TWA  
$$\text{Exempt emission rate (lbs/hour)} = \text{TLV-STEL (mg/m}^3\text{)} \times .033$$
$$\text{Exempt emission rate (tons/year)} = \text{TLV-TWA (mg/m}^3\text{)} \times .145$$
3. For toxic pollutants with only a TLV-TWA  
$$\text{Exempt emission rate (lbs/hour)} = \text{TLV-TWA (mg/m}^3\text{)} \times .066$$
$$\text{Exempt emission rate (tons/year)} = \text{TLV-TWA (mg/m}^3\text{)} \times .145$$

### Definitions:

toxic pollutant - any air pollutant for which no ambient air quality standard has been established. Particulate matter and volatile organic compounds are not toxic pollutants as generic classes of substances but individual substances within these classes may be toxic pollutants because of their toxic properties or because a TLV has been established.

threshold limit value (TLV) - the maximum airborne concentration of a substance to which the American Conference of Governmental Industrial Hygienists believes that nearly all workers may be repeatedly exposed without adverse effects.

TLV-C (threshold limit value ceiling) - the concentration of an airborne constituent that should not be exceeded during any part of the working exposure.

TLV-STEL (threshold limit value short term exposure limit) - the concentration of a constituent to which workers can be exposed continuously for a short period of time without suffering from (1) irritation, (2) chronic or irreversible tissue damage, or (3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. A STEL is defined as a 15 minute time weighted average exposure which should not be exceeded at any time during a workday even if the 8-hour TWA is within the TLV-TWA.

TLV-TWA (threshold limit value time weighted average) - the time weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

The American Conference of Governmental Industrial Hygienists (ACGIH) has established TLVs for numerous petroleum constituents. Threshold limit values for selected petroleum constituents are listed in Table Z-1.

<b>Table U-1. Threshold Limit Values for selected petroleum constituents</b>				
<b>Constituent</b>	<b>TLV-TWA</b>		<b>TLV-STEL</b>	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
benzene	10	32	---	---
ethylbenzene	100	434	125	543
hexane	50	176	---	---
naphthalene	10	52	15	79
toluene	100	377	150	565
xylene	100	434	150	651
m-xylene	---	.1 (ceiling)	---	---
Source: American Conference of Governmental Industrial Hygienists. 1991. <u>1991 - 1992 Threshold Limit Values for chemical Substances and Physical Agents and Biological Exposure Indices.</u>				

Example U-1. Example to determine if an air permit is needed for a corrective action activity

A tank owner or operator plans to initiate corrective action at a site. Corrective action involves the removal of free product and contaminated ground water. Free product will be separated from the contaminated water via an oil/water separator. Contaminated water will be sent through an air stripper in order to remove dissolved petroleum constituents. Total dissolved BTEX concentration in the influent (into the air stripper) is 50 mg/l with 12.5 mg/l benzene. The concentration of MTBE in the influent is 150 ppm. The rate at which influent enters the air stripper is 4 gallons of water per minute. It is assumed that the air stripper is 100 percent efficient in removing the volatile petroleum constituents.

Toxic Pollutants:

Benzene has the lowest TWA of any of the toxics and, therefore, is the constituent most likely to trigger the permitting requirement. The following calculations were used to determine if a permit would be required for the example system.

Influent = 4 gal/minute x 3.785 l/gallon = 15.14 liters/minute  
15.14 liters/minute x 60 minutes/hour = 908.4 liters/hour  
mass of benzene = 908.4 liters/hour x 12.5 mg/liter = 11,355 mg/hour  
11,355 mg/hr x  $1 \times 10^{-6}$  kg/mg = .011355 kg/hour  
.011355 kg/hour / .4525 kg/lb = .025 lbs/hour  
.025 lbs of benzene will be discharged from the air stripping unit into the atmosphere every hour

The TLV-TWA for benzene is 32 mg/m<sup>3</sup>. No other TLVs have been established for benzene. According to the Virginia Air Regulations, discharges of this toxic constituent of less than the following do not need a permit:

Exempt emission rate (lbs/hour) = TLV-TWA (mg/m<sup>3</sup>) x .066  
Exempt emission rate (tons/year) = TLV-TWA (mg/m<sup>3</sup>) x .145

32 x .066 = 2.11 lbs/hour (this is the maximum rate at which benzene may be discharged without a permit)

In the example site, the remediation system discharges benzene at a rate of .0215 lbs per hour. This is less than the exempt rate for benzene of 2.11 lbs/hour. The tank owner or operator, therefore, does not need a permit to discharge benzene at this rate into the atmosphere.

Total VOCs emitted from the air stripper:

If total VOC emissions from the site exceed 10 tons per year, a permit will be required. It is assumed that benzene, toluene, ethylbenzene, xylene, and MTBE comprise 80 percent of the dissolved petroleum constituents in ground water at the site.

total BTEX concentration = 50 mg/l  
MTBE concentration = 150 mg/l  
influent VOC mass = 908.4 l/hr x 200 mg/l = 181,680 mg/hr  
= .181 kg/hr  
.181 kg/hr / .4525 kg/lb = .400 lbs/hr  
24 hours/day x 365 days/year x .400 lbs/hour = 3,504 lbs/year  
= 1.75 tons of MTBE and BTEX per year

MTBE and BTEX account for 80 % of the total VOC discharge. The total VOC discharge from the system is 2.19 tons per year.

## **APPENDIX V**

### **Instructions for Completing the DCLS Lab Sheet and Lab Tag**

## Instructions for Completing the DCLS Lab Sheet

Staff must complete the following sections of the Lab Sheet:

### *Prog. Code*

This two block section refers to the program code to which the cost of sample analysis will be billed.

### *Station ID*

Station IDs will be: PCYYYY9999Z

Where: YYYY is the fiscal year for the PC #  
9999 is the numeric incident code that matches the run ID#  
Z is an alpha/numeric code regionally derived for station designation

Note: the station ID is derived from the run ID which is a CEDS identifier for the site.

### *Date Collected*

The date on which the sample was collected (year, month, day).

### *Time Collected*

The time of sample collection in military time.

### *Catalog Number*

These six blocks, divided in half by a hyphen, are used in conjunction with the group code to indicate the type of analysis being requested. The first three digits are the DEQ agency code (190). the following three digits are used to indicate the analysis being requested. These catalog numbers are found in the "DCLS catalog of Services" and in CEDS. Please note that the catalog numbers vary for the same services based on the associated group code.

### *Group Code*

These six blocks are used in conjunction with the catalog number to indicate the type of analysis being requested. The first digit is preprinted with the letter "P" indicating the sample is being received with a lab sheet. The following five digits are used to indicate the analysis being requested. The group codes for analyses to be used for drinking water samples are:

BTEX  
SVBW  
SVW  
VOCW

(revised 6/7/01)

*Priority code*

This block on the lab sheet is used to indicate the sample priority. Staff should use the codes listed in CEDS. All AWS samples should be submitted as high priority samples.

*Container #*

This set of blocks is used to indicate the number of the container associated with the lab sheet. The numbering scheme is up to the sample collector but a number should not be used more than once during a single sampling event. A "B" may be used in the first block to indicate a blank sample or a "D" may be used to indicate a duplicate sample. The number on the sample tag or label and the number in this block must match.

*Unit Code*

These blocks are used to indicate the unit or regional office which collected the sample and the unit or regional office which should receive copies of the results. The first three blocks indicate the unit number of the collector. Unit numbers are as follows:

SWRO - 001  
WCRO - 002  
NRO - 003  
PRO - 004  
TRO - 005  
VRO - 007

*Collector*

Indicate the person who collected the samples. Use up to three initials to identify the collector.

*Latitude and Longitude*

Fill in the latitude and longitude of the sample collection location if known.

*Other*

The person collecting the sample may place additional information about the sample identification in this location (e.g. Jones well). Please note that this information is for the collector's use and cannot be used to locate a sample within DCLS.

*County*

Fill in the county or city from which the sample was collected

*Comments*

The person collecting the sample should fill in any comments or observations that they had when collecting the sample (e.g. water smelled like sewage).

(revised 6/7/01)

## Instructions for Completing the DCLS Lab Tag or Sample Label

Use a #2 lead pencil or indelible ink to fill out the lab tag. The information on the back of the lab tag must exactly match the information found on the lab sheet.

### *Station ID*

Station IDs will be: PCYYYY9999Z

Where: YYYY is the fiscal year for the PC #  
9999 is the numeric incident code that matches the run ID#  
Z is an alpha/numeric code regionally derived for station designation

Note: the station ID is derived from the run ID which is a CEDS identifier for the site.

### *Date collected*

Fill in the year, month, and day that the sample was collected

### *Time collected*

Fill in the time that the sample was collected (military time)

### *Preserved?*

If a preservative was added to the sample container, place a "Y" in this box.

### *Sample # (\_\_\_/\_\_\_)*

The sample number refers to the number of containers in the shipment that are associated with a single lab sheet. DCLS analytical procedures require DEQ to provide duplicates of each sample to be analyzed. Fill in 1/2 on the sample tag for the first sample container and 2/2 on the sample tag for the duplicate sample.

(revised 6/7/01)



## **APPENDIX W**

### **General VPDES Permit for Petroleum Contaminated Sites:**

**Registration Statement**  
**Instructions for Completing the Registration Statement**  
**Termination of Coverage Request Form**  
**Transfer of Ownership Agreement Form**

## GENERAL VPDES PERMIT REGISTRATION STATEMENT FOR DISCHARGES FROM PETROLEUM CONTAMINATED SITES

- |    |   |  |            |      |
|----|---|--|------------|------|
| 1. | Legal Name of Facility_   |  |            |      |
| 2. | Location of Facility (Address and Telephone Number)   |  |            |      |
|    |   |  |            |      |
|    |   |  |            |      |
| 3. | Facility Owner  |  |            |      |
|    |   | Last Name  | First Name | M.I. |
| 4. | Address of Owner  |  |            |      |
|    |   | Street   |            |      |
|    |   |  |            |      |
|    |   | City   | State      | Zip  |
| 5. | Phone   |  |            |      |
|    |   | Home   | Work       |      |
| 6. | Nature of the business conducted at the facility_   |  |            |      |
|    |   |  |            |      |
| 7. | Type of petroleum product(s) causing or that caused the contamination._   |  |            |      |
|    |   |  |            |      |
| 8. | Which activities will result in a point source discharge from the petroleum contaminated site? (Check all that apply) |  |            |      |
|    | <input type="checkbox"/>  | Excavation Dewatering  |            |      |
|    | <input type="checkbox"/>  | Bailing Ground Water Monitoring Wells  |            |      |
|    | <input type="checkbox"/>  | Pump Tests to Characterize Site Conditions                                     |            |      |
|    | <input type="checkbox"/>  | Hydrostatic Tests of Petroleum Storage Tanks or Pipelines                      |            |      |
|    | <input type="checkbox"/>  | Pumping Contaminated Ground Water to Remove Petroleum Products From The Ground |            |      |
|    | <input type="checkbox"/>  | Other (specify)_   |            |      |
|    |   |  |            |      |
| 9. | Has a site characterization report for this site been submitted to the Department of Environmental Quality?           |  |            |      |
|    | Yes   |  | No         |      |

GENERAL VPDES PERMIT REGISTRATION STATEMENT  
FOR DISCHARGES FROM PETROLEUM CONTAMINATED SITES  
Page 2.

10. Identify the discharge point and the waterbody into which the discharge will occur. \_\_\_\_\_  
\_\_\_\_\_
11. How often will the discharge occur (e.g. daily, monthly, continuously) \_\_\_\_\_  
\_\_\_\_\_
12. Estimate how long each discharge will last \_\_\_\_\_ hours/days
13. Estimate total volume of wastewater to be discharged \_\_\_\_\_ Gal.
14. Estimate maximum flow rate of the discharge \_\_\_\_\_ Gal/day.
15. Attach a diagram of the proposed wastewater treatment system identifying the individual treatment units.
16. Attach a topographic or other map which indicates the receiving waterbody name, the discharge point(s), the property boundaries, as well as springs, other surface waterbodies, drinking water wells, and public water supplies, which are identified in the public record or are otherwise known to the applicant, within a 1/2 mile radius of the proposed discharge(s).
17. Are central wastewater treatment facilities available to this site? Yes\_\_ No\_\_ If yes, has the option of discharging to the central facilities been evaluated? What was the result of that evaluation? \_\_\_\_\_  
\_\_\_\_\_
18. Does this facility currently have a permit issued by the Board? Yes\_\_ No\_\_  
If yes, please provide permit number: \_\_\_\_\_
19. Pollution Complaint Number (if applicable) \_\_\_\_\_
20. Is the material being treated or discharged classified as a hazardous waste under the Virginia Hazardous Waste Regulation, 9 VAC 20-60-10 et seq.? Yes\_\_ No\_\_

GENERAL VPDES PERMIT REGISTRATION STATEMENT  
FOR DISCHARGES FROM PETROLEUM CONTAMINATED SITES

Page 3.

Certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations. I do also hereby grant duly authorized agents of the Department of Environmental Quality, upon presentation of credentials, permission to enter the property for the purpose of determining the suitability of the general permit.

Signature Date: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

For Department use only:

Registration Statement Accepted/Not Accepted by: \_\_\_\_\_

Date: \_\_\_\_\_

Basin \_\_\_\_\_ Stream Class \_\_\_\_\_ Section \_\_\_\_\_

Special Standards \_\_\_\_\_

**INSTRUCTIONS FOR COMPLETING THE  
GENERAL VPDES PERMIT REGISTRATION STATEMENT  
FOR DISCHARGES FROM PETROLEUM CONTAMINATED SITES**

**General**

A registration statement must be submitted to the Department of Environmental Quality in order for a discharge to be covered under the General VPDES Permit for Discharges from Petroleum Contaminated Sites.

**Questions 1 and 2: Facility Information**

Give the name of the business or other entity that occupies the site where the discharge is proposed to occur. Provide either the street address or other information that will allow DEQ personnel to locate the site. Give a telephone number at the site so that DEQ can contact someone at the facility.

**Questions 3, 4 and 5: Owner Information**

Provide the full name, street address and telephone numbers of the owner to whom the permit will be issued. This person, firm, public organization or other entity is the party responsible for the control of the facility's operation.

**Question 6: Nature of Business**

Give a brief statement as to what usual business activities are conducted at the site of contamination.

**Question 7: Type of petroleum products involved**

The type of petroleum products that are involved in the contamination will determine the conditions under which the general permit is issued. It is important to list or describe all of the materials involved.

**Question 8: Proposed activities**

Select all of the categories that apply to this proposed discharge. If events at the facility will cause the discharge to change over time from one category to another, indicate all categories that are anticipated.

**Question 9: Site Characterization**

Please indicate if a site characterization report has been submitted to the DEQ. NOTE: An SCR is required from the person responsible for conducting the release investigation and performing corrective action. If you are not a Responsible Person (RP), you are NOT required to submit an SCR.

**Question 10: Discharge Location**

Provide a narrative description of the point of discharge (e.g. northwest corner of intersection of First St. and Second Ave.) Give the name of the stream, lake, river, etc. that the discharge will go into (e.g. Unnamed Tributary to Clear Creek). If the discharge is to enter a storm drain, give the name of the owner of the storm drain system (e.g. Fairfax Co. storm drain inlet).

**Questions 11, 12, 13 and 14: Discharge Information**

Provide estimates of the frequency at which the discharge will occur, the duration of the discharge and of the amount and flow rate of wastewater to be discharged.

**Question 15: Treatment Works Design**

Attach a line drawing that traces the flow of wastewater from one treatment unit to the next. This drawing may be a sketch that shows, conceptually, what system will be used to treat wastewater so that it will meet the effluent quality requirements of the general permit. Identify all treatment technologies that will be employed at the facility.

**Question 16: Topographic Map**

The topo map should be a copy of the USGS 7.5 minute quadrangle that encompasses the facility and the surrounding property for at least 1/2 mile in all directions. Maps other than the USGS quadrangle may be substituted if they provide at least the same level of detail. The required information should be clearly marked on the map. Information regarding public water supplies and private wells may be obtained from local health department officials.

**Question 17: Central Wastewater Availability**

The owner should investigate the possibility of discharging to central sewer prior to requesting coverage under this general permit. If central sewer is in the vicinity but access for this discharge is denied, make that statement in the space provided.

**Questions 18 and 19: Permit/Pollution Complaint Numbers**

If the facility has already been permitted to discharge and has a discharge permit number, or if the facility is responsible for the release and the DEQ has issued a Pollution Complaint Number for the site, fill in the appropriate blanks with the permit or pollution complaint number. In some instances the applicant should fill in both questions; in others only one question may apply.

**Question 20: Hazardous Material Statement**

Indicate yes or no in the blanks provided. The general permit cannot be used to cover the treatment or discharge of hazardous materials.

**Certification Statement:**

State statutes provide for severe penalties for submitting false information on this registration statement. State regulations require that the registration statement be signed as follows:

For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding \$25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. {If the title of the individual signing is Plant Manager, submit a written verification that the facility employs more than 250 people or has gross annual sales or expenditures in excess of \$25 million (in 1980 dollars) and that authority to sign the registration statement has been delegated to the Plant Manager in accordance with corporate procedures.};

For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

For a municipality, state, federal, or other public agency: by either a principal executive officer or ranking elected official.

## Petroleum Discharge General Permit Termination of Coverage Request

Date: \_\_\_\_\_

Attn: \_\_\_\_\_  
(fill in name of Regional Case Manager, Storage Tank Program)

Permit #: VAG83\_\_\_\_\_

Site Name: \_\_\_\_\_  
(please match facility name listed on the Registration Statement)

Please denote your termination of coverage request by placing an "x" in front of either request 1 or 2 below (do not place an "x" in front of both requests).

1. \_\_\_\_\_ I hereby request termination of coverage under the General VPDES Permit for Petroleum Contaminated Sites for the facility listed above.
2. \_\_\_\_\_ I hereby request termination of coverage under the General VPDES Permit for Petroleum Contaminated Sites for the outfalls listed below:

Outfall Number	Outfall Description
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_

Title: \_\_\_\_\_

### FOR DEQ USE ONLY

Termination request accepted / not accepted (please circle decision) by: \_\_\_\_\_

Date: \_\_\_\_\_

GENERAL VPDES PERMIT FOR DISCHARGES FROM PETROLEUM CONTAMINATED SITES

TRANSFER OF OWNERSHIP AGREEMENT FORM

SUBJECT: Modification of VPDES Permit for Discharges from Petroleum Contaminated Sites No. VAG83\_\_\_\_\_

TO: Department of Environmental Quality  
\_\_\_\_\_ Regional Office

Attn: \_\_\_\_\_  
Environmental Manager, Remediation

I hereby agree to the transfer of ownership modification to VPDES Permit Discharges from Petroleum Contaminated Sites No. VAG836\_\_\_\_\_. As the new permittee, I agree to accept all conditions and responsibilities of the permit.

The effective date of the transfer of ownership is:

\_\_\_\_\_, \_\_\_\_.

CURRENT PERMITTEE:

NAME: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE: \_\_\_\_\_

NEW PERMITTEE:

NAME: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

TITLE: \_\_\_\_\_

DATE: \_\_\_\_\_

## **APPENDIX X**

### **AST Registration Form and Registration Renewal Form**

The AST Registration Form and Renewal Form are available on the DEQ Petroleum Program Web Page ([www.deq.state.va.us/tanks/](http://www.deq.state.va.us/tanks/)). Please download these forms from that page.



## **APPENDIX Y**

### **DEQ Storage Tank Program White Paper: Applicability of Articles 9, 10, and 11 of Virginia Water Control Law to USTs at Manufactured Gas Plants**

# MEMORANDUM

**DEPARTMENT OF ENVIRONMENTAL QUALITY**  
DIVISION OF ENVIRONMENTAL IMPROVEMENTS  
OFFICE OF SPILL RESPONSE AND REMEDIATION

Mail Address:  
P.O. Box 10009  
Richmond, VA 23240

Location:  
629 East Main Street  
Richmond, VA 23219

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**SUBJECT:** Applicability of Articles 9, 10, and 11 of Virginia Water Control Law to USTs and Manufactured Gas Plants

**TO:** J. Andrew Hagelin

**FROM:** James Barnett

**DATE:** August 31, 1999

**COPIES:** Larry Lawson, Fred Cunningham, Dave Chance, Mary-Ellen Kendall, Russ Ellison, Larry McBride, Al Willett, Cindy Sale, Dan Manweiler, Bruce Davidson, R. McChesney Sterrett

Former manufactured gas plants may be found in many of the cities in towns throughout the Commonwealth and contamination from these sites is often encountered by DEQ staff. The attached White Paper discusses the applicability of Articles 9, 10, and 11 of Virginia Water Control Law to USTs at former manufactured gas plants.

Historically, the Superfund and Voluntary Remediation Programs within the DEQ Waste Division have overseen the investigation and cleanup of these sites. Tars and oils remaining at these sites also may be hazardous wastes. DEQ Storage Tank Program staff encountering contamination from a former manufactured gas plant should refer the site to the DEQ Waste Division. If the DEQ Waste Division determines that the cleanup at a manufactured gas plant cannot be administered under CERCLA or RCRA Subtitle C and there is no entity willing to undertake the cleanup under the Voluntary Remediation Program, the DEQ Storage Tank Program may oversee the cleanup of tars and oils at the site under Articles 9 or 11 of Virginia Water Control Law.

Storage Tank Program staff serving on the Technical Manual Task Force determine the issues that need to be addressed in the Technical Manual. The information presented in the attached White Paper will be discussed by the Technical Manual Task Force for possible inclusion in the Technical Manual.

# Applicability of Articles 9, 10, and 11 of Virginia Water Control Law to USTs at Manufactured Gas Plants

## Issue statement

Manufactured gas plants operated in the United States from the early years of the 1800s into the early 1960s. During the process of manufacturing gas, tars, oils, and oily water were generated. These materials often contaminated the land and water at and near the manufactured gas facility and contaminants from the manufacturing process often remain to the present time. Questions have been posed regarding the applicability of the UST Technical Regulation to coal tar USTs at these former manufactured gas plants. The purpose of this document is to evaluate the applicability of Articles 9, 10, and 11 of Virginia Water Control Law to USTs at former manufactured gas plants.

## Discussion

### I. Background----The Gas Manufacturing Process

Three major processes were used to manufacture gas in the United States: coal carbonization, carbureted water-gas, and oil gas (Harkins et al. 1987). Coal carbonization consisted of heating bituminous coal in a sealed chamber, with destructive distillation of gas from the coal and the formation of coke. The gases were collected, cleaned, and distributed while coke was removed and sold or used. The carbureted water-gas process used coke or coal, steam, and various petroleum products to produce a combustible product gas. Steam was fed through a bed of incandescent coke, producing a gas containing hydrogen and carbon monoxide. This gas then passed through two chambers containing hot firebrick where a petroleum product was sprayed into the gas and cracked into hydrocarbons and tar (Harkins et al 1987). The oil gas process involved cracking oil alone into gaseous hydrocarbons, tar, and carbon.

The type of gas production methods used varied by time and region. Coal carbonization was the principal gas production method used throughout the U.S. until the late 1800s because relatively inexpensive oil was not available until that time (Harkins et al 1987). Gas production in the north central US remained principally coal carbonization throughout the manufactured gas era. The oil-gas process was predominant on the West Coast. In the South, East, and Northeast, coal carbonization was predominant until the late 1800s to early 1900s at which time most of the manufactured gas plants converted to a carbureted water process. The regional variation in production processes used was predominantly related to the relative cost of the raw materials needed for production and the markets for byproducts in the various regions.

#### I.A. Tars and Oils from Manufactured Gas Plants --- General

Though combustible gas was considered the primary product of manufactured gas plants, tars and oils were generated as byproducts from all three gas production processes. These tars and oils were generally recovered as byproducts from the production of gas and they were usually separated from condensate water by gravity separators. According to Harkins et al. (1987), tars and oils generated by the gas production process were an economic resource to the gas manufacturer. These materials could be refined to make various chemical products (e.g. creosote) or, if market prices for tar and oils were unfavorable, they could be used as boiler fuels at the gas manufacturing facility.

#### I.B Tars Generated at Manufactured Gas Plants

Tars generated by the gas manufacturing process may be thought of as nonaqueous liquid hydrocarbons of very complex compositions having a specific gravity greater than that of water. These tars were produced by the destructive distillation or partial combustion organic matter.

Tars produced by manufactured gas processes fit into three general categories depending upon the production process (Harkins et al. 1987). Coal tars were nonaqueous phase liquids produced by the partial combustion or destructive distillation of coal. Coal tars contained mostly aromatic hydrocarbons including benzene, naphthalene, anthracene, and related compounds. They also contained phenolic compounds and tar bases.

Oil tars were nonaqueous fluids produced by the destructive distillation or thermal cracking of petroleum oils. These oil tars were composed mostly of aromatic hydrocarbons including benzene, toluene, naphthalene, phenanthrene, and methyl anthracene. Oil tars were noticeably different from their coal tar counterparts in that they contained almost no tar acids (phenols) and tar bases (Bateman 1922).

Water-gas tar is the tar produced from the oil that is cracked from petroleum oils in the carburetor of carbureted water-gas plants. Tar from the carbureted water-gas process is very similar to the tar produced by the oil-gas process and may be distinguished from coal tars by its lack of phenols and tar bases (Bateman 1922).

#### I.C Oils Generated at Manufactured Gas Plants

Oils generated by the gas manufacturing process are distinguished from tars in that they are the liquid hydrocarbon mixtures having a specific gravity less than that of water. Lightweight oils were recovered from oil-gas, carbureted water-gas, and coal carbonization gases at manufactured gas plants. These lightweight oils were scrubbed out of the gas by a relatively heavy oil and then separated from the tar by distillation. Principal components in lightweight oils include benzene, toluene, and xylenes.

Another type of oil found in association with manufactured gas plants was “drip oil.” Drip oil was any hydrocarbon mixture that condensed as a liquid in the gas holder, meter, or mains. After the gas was produced and cleaned, some heavier fractions remained in the gaseous state. As the gas cooled further to ambient temperatures, some of these heavier organics condensed. This organic condensate or “drip oil” was collected in special tanks at the low end of the gas mains. The collected drip oil was then either mixed with the raw tar or recovered light oils and sold to processors or used as a fuel at the manufactured gas facility. Drip oil was composed mostly of light hydrocarbon fractions including benzene, toluene, and xylenes (Harkins et al. 1987).

## II. Applicability of Article 9 and the UST Technical Regulation

Underground storage tanks (USTs) meeting the definition of UST under Article 9 and the UST Technical Regulation are regulated if they are used to store a regulated substance and are not otherwise exempt from the definition of UST. Regulated substances are broken down into: (1) any substance defined in §101(14) of CERCLA; and (2) petroleum. Neither coal tar nor oil tar are listed in the CERCLA list as regulated substances nor are the light oils that were generated during the manufacturing process.

### II.A Tars and Oils from Manufactured Gas Plants as Petroleum

Petroleum as outlined in the UST Technical Regulation includes crude oil or any fraction thereof that is a liquid at conditions of standard temperature and pressure. Coal tar and light oils resulting from the process of manufacturing gas via the coal carbonization process were derived from coal, not crude oil. Therefore, coal tar and oils generated via the coal carbonization process do not qualify as “petroleum” under the UST regulation.

According to Harkins et al (1987), the majority of manufactured gas plants in the eastern and southern U.S. converted from using the coal carbonization process to the carbureted water-gas process during the early 1900s. Petroleum feedstocks were used in the carbureted water-gas process to generate gas. The first carburetion oils used were composed primarily of the naphtha fraction of petroleum consisting of compounds between the gaseous hydrocarbons and kerosene. After World War I, increased demand for gasoline produced from the naphtha fractions of petroleum led the producers of manufactured gas to switch from naphtha to gas oils. The gas-oil fraction of petroleum was between kerosene and lubricating oils. The use of gas oils became less attractive after catalytic cracking of the gas-oil fraction into heavy fuel oils and gasoline was adopted by petroleum refineries. This alternative use of the gas oils competed with the manufactured gas industries' use of the gas-oil fraction increasing prices and causing some shortages of gas oil. The manufactured gas industry subsequently switched from gas-oil to heavy fuel oils for the manufacture of carbureted water-gas. The oil feedstocks used to generate gas were petroleum fractions derived from crude oils and, therefore, would be considered petroleum (a regulated substance). USTs used to store these feedstocks would be regulated under the UST Technical Regulation.

Tars and oils generated via the carbureted water process would be considered petroleum (a regulated substance) since they were derived from crude oil or fractions thereof and were liquids at standard temperatures and pressures. USTs containing these tars and oils may be regulated under the UST Technical Regulation depending upon how the tank was used in the process of recovering these fluids (see the liquid trap exemption below).

## II.B Coal Tar and Oil from Gas Manufacturing Plants as a CERCLA Listed Regulated Substances

Regulated substances are those substances defined in §101(14) of CERCLA excluding those substances regulated as hazardous wastes under RCRA. Coal tar as an individual or unique chemical substance is not listed on the CERCLA list as a regulated substance. Coal tar (CAS# 8007-45-2) is a complex and variable mixture of heavy hydrocarbons obtained by the destructive distillation of coal. According to EPA (1999), coal tar generally consists of 2-8 percent light oils (principally benzene, toluene, and xylenes), 8-10 percent middle oils (predominantly phenols, cresols, and naphthalene), 8-10 percent heavy oils (naphthalene and derivatives), 16-20 percent anthracene oils, and about 50 percent pitch. Many of the individual constituents present in coal tar including, but not limited to, benzene, toluene, xylenes, cresols, naphthalene, and anthracene are regulated substances and present in coal tar above *de minimis* concentrations. Coal tar USTs may, therefore, be hazardous substance USTs and subject to the requirements of the UST Technical Regulation due to the presence of one or more regulated substances within the coal tar depending upon how the tank was used in the gas manufacturing process (see the liquid trap exemption below).

Coal tar creosote (CAS# 8001-58-9) and creosote (CAS# 8001-58-9) are listed synonyms in the chemical abstracts for coal tar despite these materials having a different chemical abstract number than that of coal tar. Creosote is a yellowish to greenish-brown oily liquid distilled from coal tar and used as a wood preservative and pesticide. Creosote (CAS# 8001-58-9) is a listed regulated substance under CERCLA and USTs containing creosote would be regulated provided that the tank is not otherwise exempted or excluded from the requirements of the regulation.

NOTE: While creosote is reportedly a product distilled from coal tar, the chemical differences between coal tar and creosote may be slight. This similarity between coal tar generated from the gas manufacturing process and creosote used in treating wood causes makes it difficult to determine whether a tank contained creosote or coal tar. The Storage Tank Program will, as a default position, consider all tanks at former manufactured gas plant sites containing high concentrations of PAHs to be coal tar tanks unless site specific information indicates that the material in the tank was used without further refining or distillation for treating wood.

II.C USTs that are Exempted from Article 9 and the UST Technical Regulation (Liquid Trap Exemption for Drip Oils)

Liquid traps or associated gathering lines directly related to oil or gas production and gathering operations are exempt from the requirements of the UST Technical Regulation. According to the Federal Register (Vol. 53, No. 185),

“the liquid trap exclusion refers to sumps, well cellars, and other traps used in association with oil and gas production, gathering and extraction operations (including gas production plants), for the purpose of collecting oil, water, and other liquids. Such liquid traps may temporarily collect liquids for subsequent disposition or reinjection into a production or pipeline stream, or may collect and separate liquids from a gas stream. This exclusion applies only to traps and gathering lines, and does not include other storage tanks at oil and gas production sites.”

Drip oil was often collected in special tanks at the low end of the gas mains (Harkins et al. 1987). Since these drip oil collection tanks were usually underground, they would be considered USTs. These tanks, however, would be exempt from the requirements of the UST Technical Regulation because they are liquid traps associated with gas production.

Tar may have been collected at any number of places within the gas manufacturing process. According to Harkins et al. (1987), tars and condensate were collected from the washbox, condenser, relief holder, and tar extractor (see Figure 1 for a flowsheet for a carbureted water gas plant). Since these components of the gas manufacturing process were used to separate liquids from the gas, they would be exempt from the requirements of the UST Technical Regulation.

Another location where tars would have been encountered was the tar separator. The tar separator was used to separate tar, water, and light oil. Since this tank was not part of the treatment train for removing liquids from the gas, this tank would be regulated if it were an UST and contained regulated substances.

II.D. Tars and Oils from Manufactured Gas Plants as Hazardous Wastes (the hazardous waste exclusion)

USTs containing hazardous wastes are excluded from the requirements of Article 9 and the UST Technical Regulation. Tars and oils remaining at former manufactured gas plants may be solid wastes by virtue of being discarded by being abandoned (EPA 1999). If these tars and oils are deemed to be solid wastes then the applicability of hazardous waste requirements to these materials also must be evaluated.

According to DEQ Hazardous Waste staff and the EPA (1999), coal tar is not likely to be a listed hazardous waste. Listed wastes K087 and K141 through K148 are for coking operations and are not applicable to coal tar found at former manufactured gas plants.

Coal tar, as previously discussed, is a complex material composed of many constituents. Both coal tars and oils generated from the gas manufacturing process often contain significant concentrations

of benzene. Wastes contaminated by these tars and oils may be characteristically hazardous due to elevated concentrations of benzene.

### III. Applicability of Article 11 to Tars and Oils generated at Manufactured Gas Plants

Article 11 of Virginia Water Control Law prohibits the discharge of oil into state waters, upon state lands, or into storm sewers. Oil as defined in Article 11 means oil of any kind and in any form, including, but not limited to, petroleum and petroleum by-products, fuel oil, lubricating oils, sludge, oil refuse, oil mixed with other wastes, crude oils and all other liquid hydrocarbons regardless of specific gravity. Tars and oils generated at manufactured gas plants are liquid hydrocarbons and the definition of oil indicates that the source of the tar and/or oil (i.e. coal vs. oil) is irrelevant. Therefore, Article 11 also may be applied to the discharge of tars and oils from manufactured gas plants.

### IV. Applicability of Article 10 (VPSTF Reimbursement)

When cleanups are required by the DEQ Storage Tank Program, persons conducting the cleanup often request reimbursement from the Virginia Petroleum Storage Tank Fund (VPSTF) for approved, eligible cleanup costs. In general, fund-eligible releases are: (1) releases of petroleum from regulated, deferred, excluded and farm USTs, discharges of oil from heating oil USTs and ASTs, and discharges of VPSTF fee petroleum products from ASTs.

Costs associated with cleaning up releases from hazardous substance USTs are not eligible for reimbursement. Therefore, USTs containing creosote or other hazardous substances discussed earlier would not be eligible for reimbursement. Costs incurred for cleaning up releases from ASTs containing oil may be eligible for reimbursement if the tank operator can show the fund fee was paid on the product in the tank.

Costs incurred for cleaning up releases from petroleum USTs that are subject to the requirements of the UST Technical Regulation are eligible for reimbursement. Therefore, releases from regulated USTs that contained tar and/or oil derived from crude oil would be eligible for reimbursement.

## Summary

Historically, the investigation and/or cleanup of manufactured gas plants in Virginia has been administered by either the Superfund Program or the Voluntary Remediation Program. This remains the preferred option. Given the types of contaminants likely to be found at gas manufacturing plants and the regulatory/statutory framework involved, the DEQ Waste Division is better able to effect a cleanup of all constituents than is the Storage Tank Program. The nitrogen and cyanide compounds produced during gas manufacturing are not oils and, therefore, cannot be addressed under Article 11. If the DEQ Waste Division determines that a particular cleanup cannot be handled under the Hazardous Waste Program or the Superfund Program, and there is no entity willing to undertake the cleanup under the Voluntary Remediation Program, then the Storage Tank Program may oversee cleanup of oils and tars under Article 11 of the State Water Control Law. It is also hypothetically possible that (all or a portion of) the cleanup of oils and tars may be

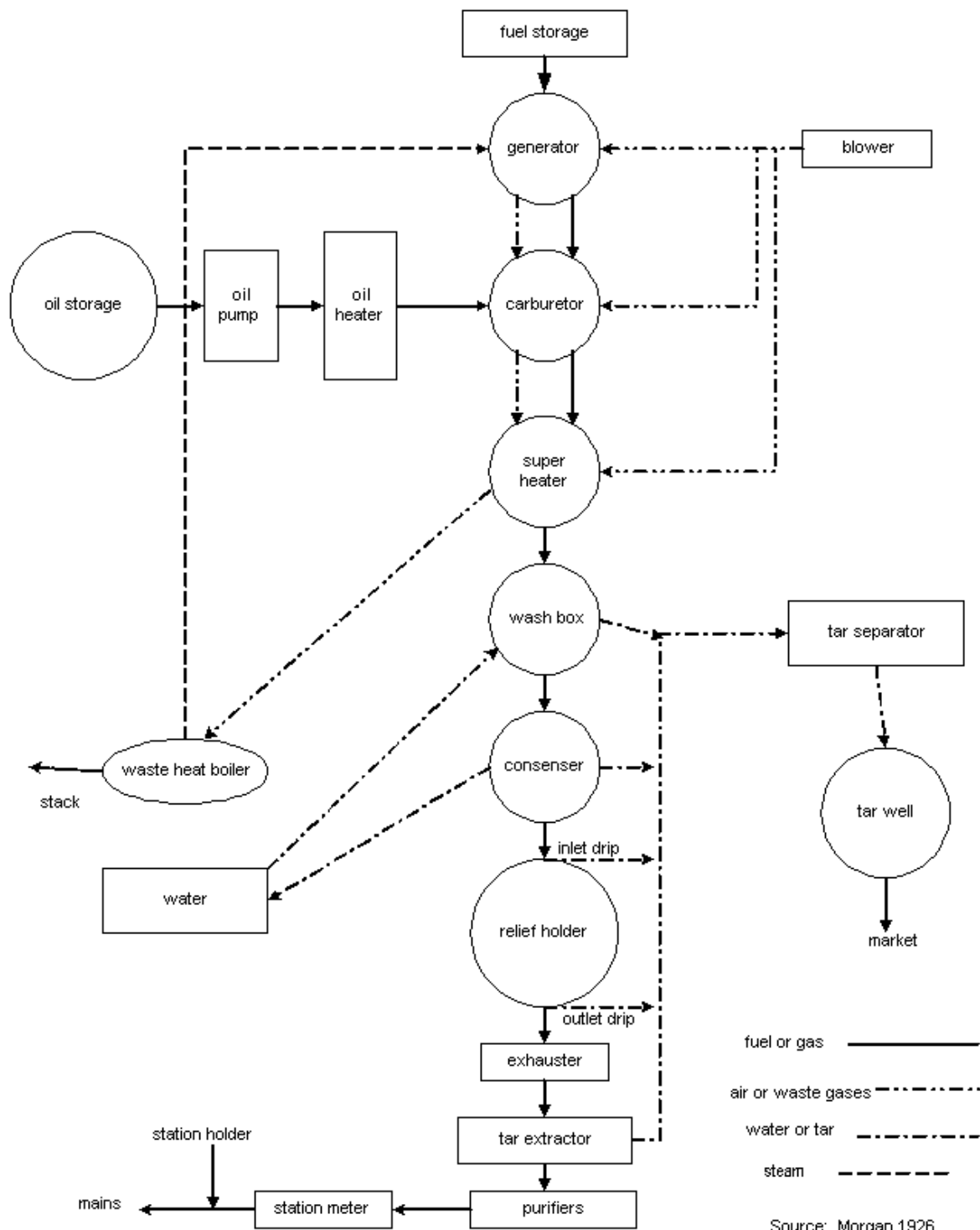


administered under Article 9 and the UST Technical Regulation, but the uncertainties and complex histories of these sites make this unlikely. In order to invoke Article 9 and the UST Technical Regulation, DEQ must possess or be presented with detailed historical and technical information which documents that the release is from a regulated UST and not from any other source.

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Figure 1. Flowsheet for a carbureted water-gas plant



## **APPENDIX Z**

### **Sampling Guidelines and Procedures**

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## **APPENDIX Z**

### **Sampling Guidelines and Procedures**

#### **Petroleum Storage Tank Sites**

The DEQ Storage Tank Program relies on information generated from sample analyses to determine appropriate courses of action at individual sites. Information from samples must be of a sufficient and known quality to support the decision making process. Procedures discussed below provide general guidelines for collecting samples that are expected to meet the data quality objectives needed for storage tank closure and release response and corrective action. These sample collection procedures are not required and persons collecting samples are encouraged to develop and use sample collection procedures that account for site specific conditions. The DEQ Storage Tank Program also encourages persons to consult the laboratory that they plan to use for any special requirements before developing sampling procedures that they will use at a particular site. When sample collection procedures used at a site differ from those outlined here, DEQ expects these procedures to be outlined in the report containing the analytical results for samples collected using those procedures.

In all instances, DEQ expects the person collecting samples to use sound professional judgment when collecting samples and perform all field work in accordance with all applicable OSHA requirements.

#### **Z.1 Data Quality Objectives – Soil Samples**

During the processes of storage tank closure and release response/corrective action, soil samples are often collected and analyzed to support decisions that must be made about the site. Soil samples collected during storage tank closure must be collected from locations that would most likely be impacted if a release occurred. These locations usually include soil in close proximity to the tank, product lines, and dispensers and DEQ expects these locations to be among the most contaminated at a site.

Samples collected during site characterization must provide information about the severity and extent of contamination at the site. Information obtained from these samples must support the risk based decision making process for the site. Risk-based corrective actions are based on the principle of reasonable maximum exposure. This principle makes it necessary for DEQ to have information about the severity of contamination at the site so that an upper boundary condition for risk (i.e. reasonable maximum exposure) may be estimated.

Update III to SW846 specifies different sampling and analytical procedures for “high level” and “low level” soil samples. Where information is needed about concentrations of volatile organic compounds (VOCs) in soil that are less than 200 ug/kg, “low level” procedures are used<sup>x-1</sup>. When information is needed about VOC concentrations in soil above 200 ug/kg, “high level” sampling

and analytical procedures are used. Replicate samples for analysis and moisture determination should be collected as recommended in SW-846. Given the intended uses of soil sample data, soil samples that will be analyzed for VOCs should be collected and analyzed in accordance with the “high level” procedures unless the DEQ Case Manager specifies the need for “low-level” analyses. Sample collection and preservation requirements for VOCs outlined below are for “high-level” analyses

All samples for determining contaminant levels at a tank site should be discrete (i.e. individual grab samples, not composites) and representative of the area from which the sample was collected. This information is needed so that reasonable maximum risks from the release may be estimated.

## Z.2 Constituents of Concern

The constituents of concern that DEQ expects responsible persons and consultants to investigate at petroleum storage tank sites are based upon the type(s) of petroleum products stored at the site, the age of the petroleum products, and the risks posed by products potentially released from the site. Soil samples collected from petroleum storage tank sites will usually be analyzed for some or all of the following parameters:

- BTEX
- TPH (gasoline range compounds)
- TPH (diesel range compounds)
- Semi-volatile organics (PAHs)
- MTBE
- Tetraethyl lead

Once soil samples are obtained from the appropriate sampling locations, this soil must be placed in containers appropriate for the analyses to be performed. A list of analytical methods considered approved by the DEQ Storage Tank Program may be found in Table 5-3.

NOTE: Soil contaminated by kerosene, jet fuels, diesel, fuel oils, crude oil, Varsol®, and used oil may be analyzed for TPH (diesel range compounds)

<sup>x-1</sup> The severity of soil contamination is also an important consideration when determining whether to analyze samples by “low level” or “high level” procedures. Heavily contaminated soil cannot be analyzed by the “low level” procedure.

## **Z.3 Sample Collection and Preservation - Volatile Organic Compounds (VOCs) in Soil**

When soil samples will be analyzed for volatile organic compounds (VOCs) including BTEX, MTBE, and/or TPH - gasoline range compounds, samples must be collected and stored in a manner that will reduce, to the extent possible, the loss of volatiles. Persons collecting samples that will be analyzed for VOCs should ensure that samples are collected only from freshly exposed surfaces. If soil must be moved from a sample collection device (e.g. soil probe) to a sample container, this operation should be performed as quickly as possible so that VOC losses are minimized. To minimize VOC loss, soil samples must be collected and stored in a sampling container as soon as possible using one of three sampling options listed below. Regardless of which method is employed, care should be taken to avoid exposing the soil matrix to the atmosphere.

When the soil will be analyzed for VOCs, Method 5035 in Update III to SW846 specifies that the soil must be placed in:

1. EPA-approved volumetric sampling devices such as the EnCore® sampler, (requires the collection of an additional bulk sample for moisture);
2. 40 ml vials (requires the collection of an additional bulk sample for moisture) and/or;
3. Unpreserved bulk sample containers.

### **Z.3.1 EPA Approved Volumetric Sampling Devices**

Volumetric samplers are sample collection devices that can be used to collect a known volume of soil. Using a volumetric soil sampler permits a discrete sample to be collected without disturbing the soil matrix. Procedures for collecting samples with a volumetric sampling device may vary depending upon the device used and persons collecting samples should follow the manufacturer's instructions. General instructions for using a volumetric sampler are as follows:

1. Insert the sampler into the soil until the sampler is completely full. It is important to eliminate all headspace and voids;
2. Wipe all excess soil and grit from the sampler body exterior;
3. Secure the cap on the sampler; and
4. Label the sample container and place in a cooler.

Samples collected using an approved volumetric sampler do not require preservation in the field (prepping). These samples must, however, be cooled to 4° C. Soil samples not preserved in the field that will be analyzed for volatile organics must be preserved within 48 hours after the sample was collected. Samples collected using a volumetric sampler should, therefore, be prepped and analyzed as soon as possible upon reaching the lab.

Volumetric-type samplers are designed to collect discrete samples and are not appropriate sampling devices when composite samples must be collected (i.e. for soil disposal).



### **Z.3.2 40 ml vials**

The DEQ believes that volumetric samplers are more convenient to use in many instances than field preserved samples in 40 ml vials and the losses of VOCs from volumetric samplers are expected to be lower than the losses of VOCs from bulk sample containers. Persons using volumetric samplers should be aware that the effectiveness of these sampling devices may be limited by site-specific soil conditions. Competent rock, gravel, weathered rock, tight clays, and other similar materials are not effectively collected by most volumetric samplers. Field preservation of soil samples to be analyzed for VOCs involves the addition of an appropriate volume of preservative to the 40 ml vial in the field immediately after the sample is collected. A new plastic syringe with the needle end cut off and rubber plunger tip removed is used to collect between 5 and 25 grams of soil. This soil is then placed in the 40 ml vial and preserved with methanol at a ratio of 1 gram of soil to 1 milliliter of methanol. If samples cannot be weighed in the field to calibrate the syringe, the person collecting samples may estimate the weight of soil collected by assuming that 1cc of soil weighs approximately 1.7 grams.

Update III to SW846 indicates that soil samples to be analyzed for VOCs may be placed in and preserved in 40 ml vials having silicone rubber-coated screw tops with polytetrafluorethylene (PTFE) septa. Preservation of samples placed in 40 ml vials takes place in the field at the time of sample collection and is performed either by:

1. measuring the preservative in the field and placing it in the vial (field preservation) with the sample; or
2. using 40 ml vials already containing a pre-measured volume of preservative.

#### Z.3.2.1 Field Preservation

To collect a discrete undisturbed sample:

1. Place an appropriate aliquot of methanol, based on sample weight, into the vial;
2. Push the syringe into the soil;
3. Immediately extrude the sample into the vial containing methanol and wipe the threads and top lip clean of any grit or soil;
4. Screw the PTFE septa top onto the vial and gently swirl the mixture in the vial so that the preservative saturates the entire amount of sample (**DO NOT SHAKE!**); and
5. Label the vial as appropriate, place in a cooler, and maintain at 4° C until delivered to the lab.

NOTE: Section 2.2.2 of SW-846, Method 5035 indicates that soil and a water miscible solvent such as methanol are combined in a 1:1 ratio to preserve soil samples for “high-level” analyses. By contrast, Section 6.1.3 of the same method states that the proper ratio for preserving samples for “high-level” analyses is 1:2. According to a memo dated August 7, 1998, from the EPA Office of Solid Waste, a ratio of 1:1 should be used provided that the amount of solvent used is sufficient to submerge the entire plug of soil. If the amount of solvent is insufficient to cover the plug of soil, EPA states that a 1:2 ratio of soil to solvent should be used.

### Z.3.2.2 Pre-preserved 40 ml Vials

In lieu of adding preservative to the vial at the time of sample collection, preservative may be placed in vials prior to sample collection. Persons taking vials already containing preservative into the field should be aware that vials may lose preservative, especially if they are stored for extended periods of time prior to use. Therefore, vials containing preservative should be weighed again on the same day they are used to check for losses of preservative greater than .01 gram. Once in the field, the person collecting samples will use a new plastic syringe with the needle end cut off and rubber plunger tip removed. The syringe will be inserted into the soil at the designated sampling location and used to extract between 5 and 25 grams of soil depending upon the volume of methanol in the vial. This soil will then be extruded into the pre-preserved 40 ml vial. The appropriate ratio of soil to preservative is 1 gram of soil per milliliter of methanol (see note above). If samples cannot be weighed in the field to calibrate the syringe, the person collecting samples may estimate the weight of soil collected by assuming that 1cc of soil weighs approximately 1.7 grams.

To collect a discrete undisturbed sample:

1. Determine the volume of methanol in the sample vial;
2. Push the syringe into the soil;
3. Immediately extrude the soil sample into the vial containing methanol and wipe the threads and top lip clean of any grit or soil;
4. Screw the PTFE septa top onto the vial and gently swirl the mixture in the vial so that the preservative saturates the entire amount of sample (**DO NOT SHAKE!**); and
5. Label the vial as appropriate, place in a cooler, and maintain at 4° C until delivered to the lab.

### **Z.3.3 Bulk Soil Samples**

Update III to SW846 allows persons to place soil that will be analyzed for VOCs in glass containers that are larger than 40 ml provided that those containers have screw caps and PTFE liners. These larger glass containers can also be used to collect samples to be analyzed for soil moisture (required when one of the EPA approved volumetric sampling devices or the 40 ml vials are used).

To minimize the loss of volatiles from samples stored in bulk containers, the following procedures are recommended:

1. Place soil into the containers gently to reduce agitation that may drive off volatile compounds and pack the container tightly with soil to eliminate headspace;
2. Wipe the threads and top lip of the sample container to remove grit or soil;
3. Screw the cap onto the sample container;
4. Label the container as appropriate; and
5. Place the container in a cooler and maintain at 4° C until delivered to the lab.

## **Z.4 Sample Collection - Semi-Volatile Organic Compounds (SVOCs) and Inorganic Constituents**

Soil samples that will be analyzed for semi-volatile organic compounds (SVOCs) including PAHs and/or TPH - diesel range organic compounds should be placed in glass sample containers that have screw caps and PTFE liners. A procedure that may be used for collecting soil samples to be analyzed for SVOCs is as follows:

1. Place soil into the containers gently to reduce agitation that may drive off volatile compounds and pack the container tightly with soil to eliminate headspace;
2. Wipe the threads and top lip of the sample container to remove grit or soil;
3. Screw the cap onto the sample container;
4. Label the container as appropriate; and
5. Place the container in a cooler and maintain at 4° C until delivered to the lab. Bulk samples for VOCs must be prepped and extracted within 48 hours of collection and within 14 days after extraction.

NOTE: Soil samples that will be analyzed for metals should also be placed in glass sample containers that have screw caps and PTFE liners. Preparation and preservation requirements for samples to be analyzed for metals are different than the requirements for VOCs.

## **Z.5 Sample Collection Guidelines - Soil sample locations**

During the process of closing storage tanks or performing release response and corrective actions, soil samples may be collected from a variety of locations including, but not limited to the ground surface, excavations, trenches, and borings. Unless specified otherwise by the Case Manager, the DEQ expects soil samples to be collected from areas that will show the maximum soil contamination in a particular area. If contamination is not apparent at the time of sampling, soil samples should be collected from just above the water table (i.e. the capillary fringe). When a site is characterized following a confirmed release, the DEQ expects persons characterizing the site to determine the thickness of the zone of soil contamination. Unless an alternate procedure is decided upon by the DEQ case manager, tank owner/operator, and consultant, soil borings should, at a minimum, extend through the zone of water table fluctuation to evaluate residual contamination in this area.

*All soil samples collected for release response and corrective action as well as tank closure must be collected from discrete locations. Each sample location and depth must be documented on a site map that is submitted to DEQ for review. Composite samples are not acceptable, except for waste disposal.*

## **Z.5.1 Collecting soil samples from excavations and trenches**

Soil samples collected from excavations and trenches should be collected from the most heavily contaminated part(s) of the excavation and/or trench. Each individual soil sample collected from an excavation or trench must be collected from a discrete location within that excavation or trench.

Soil may be taken from an excavation or trench by using a volumetric sampler, a clean soil probe or soil auger, a backhoe bucket or other device depending upon site conditions. When deciding upon the method with which to collect soil, persons collecting samples are expected to abide by all applicable OSHA requirements and exercise professional judgment regarding personal safety. In no instance should an individual enter an unsupported confined space (e.g. an unshored excavation) or other area where potential risks of personal injury or death are high.

NOTE: Before samples are collected from a trench, it is recommended that the wall surface of the trench be scraped to remove the surface layer of soil which may have been smeared across the trench wall by the backhoe bucket.

### **Z.5.1.1 Collecting soil samples with a soil auger or a soil probe**

When the person collecting samples cannot directly reach the desired sample collection location within a trench or excavation, that person may use a soil auger, with additional flights as necessary to reach the area of concern. DEQ prefers the use of soil augers instead of backhoe buckets for collecting samples from remote locations in an excavation or trench because the person collecting the sample has greater control over the sampling location and the sample collected is more discrete and undisturbed. When a soil auger will be used to collect soil samples from an excavation or trench, the person collecting the sample must determine the locations within the excavation that are expected to represent the maximum contamination in the area. When collecting soil samples from a tank pit during tank closure, the most heavily contaminated soil is expected to be found: (1) immediately below the source (water table is well below the source); or (2) just above the water table (shallow water table, water table above the source). In all cases, the person collecting samples must provide justification and descriptions for all sample collection locations.

When a soil auger will be used to collect soil samples from an excavation, the following sample collection procedure may be followed:

1. Advance a clean, decontaminated hand auger into the area of concern until the one auger bucket of material has been collected.
2. Don clean latex gloves and remove the first centimeter (approximately) from the bit end of the auger and discard that soil.
3. Remove the soil from the bit end and place that soil in the sampling containers that are appropriate for the analyses to be performed.
4. Label the sample containers.

5. Record information about soil texture, odor, color, and other soil characteristics. If the sampler plans to screen multiple samples and send only the most contaminated samples to the lab, soil from the auger should be split into the appropriate sample container(s) and a plastic bag. It is recommended that persons screening soil in this manner, place soil in the appropriate sample container first and then place the remaining soil in a plastic bag.
6. Place soil remaining in the auger after sample collection back in the excavation.
7. Decontaminate the auger using a detergent solution and deionized water before another soil sample is collected.

#### Z.5.1.2 Collecting soil samples with a backhoe bucket

Although not as discrete as a soil auger, a backhoe bucket may be used to collect soil from locations in an excavation or trench that are inaccessible by other methods. When a backhoe bucket will be used to collect soil samples, the following practices are recommended:

1. Determine the location from which to collect a sample;
2. Scrape the surface of the trench at the desired sampling location with a clean shovel or other device to reduce cross contamination caused by smearing during the excavation process;
3. Retrieve soil using the backhoe bucket;
4. Don clean latex gloves and collect the sample from the center of the backhoe bucket using the sample collection and preservation methods previously described.  
NOTE: Decontamination of a backhoe bucket between samples is not practicable, therefore, samples collected from a backhoe bucket should be taken from a location that is not in direct contact with the machinery.
5. Label the sample containers.
6. Record information about soil texture, odor, color, and other soil characteristics. If the sampler plans to screen multiple samples and send only the most contaminated samples to the lab, soil from the backhoe bucket should be split into the appropriate sample container(s) and a plastic bag. It is recommended that persons screening soil in this manner, place soil in the appropriate sample container first and then place the remaining soil in a plastic bag.
7. Place soil remaining in the backhoe bucket after sample collection back in the excavation.

#### **Z.5.2 Collecting soil samples from borings**

During the course of investigating a release, soil samples must often be collected from borings. Borings may be advanced with any number of types of drill rigs or direct-push type systems. Many of these systems use a split-spoon type sampling device to collect soil and the procedure that follows is for collecting soil samples with a split spoon.

When collecting samples from borings via a split-spoon or other sample collection device, samples should be collected at intervals that are agreed upon by the consultant, responsible person, and the

Regional Case Manager. Generally, the sample collection interval is one split-spoon sample per five feet of boring, however, the sampling interval may vary depending upon the level of information required. Once the desired sampling depth is attained, soil samples will usually be collected by the following procedure:

1. Advance the split-spoon into the undisturbed soil at the lower limit of the boring.
2. Remove the split-spoon from the boring.
3. Don clean latex gloves and open the split spoon.
4. Collect the sample from the part of the recovered material that is believed to be most heavily contaminated and representative of the soil that is present in the area of interest. Soil should not be collected from the rear or upper end of the split spoon as this soil may have fallen back into the open bore hole and may not be representative of the soil in the area of interest.
5. Label the sample containers.
6. Note soil texture, PID/FID readings, and other soil characteristics in the log book.
7. Discard the soil remaining in the split-spoon. This soil may be placed back in the boring, placed and managed on site in accordance with DEQ Storage Tank Program procedures for managing petroleum contaminated soil (See Sections 6.2 through 6.2.5), or contained and taken off site for treatment or disposal.
8. Decontaminate the split-spoon using a detergent solution and deionized water.
9. Re-assemble the split-spoon prior to the collection of another sample.

NOTE: Unless otherwise directed, the DEQ expects persons characterizing releases to prepare a descriptive boring log for each soil boring.

### **Z.5.3 Collecting Soil Samples with a Direct Push Unit**

Direct-push technologies were developed as a means of collecting many samples from the subsurface within a relatively short period of time. Direct-push units may use a variety of tools for retrieving soil from the subsurface. Several of the more common soil sample tools used in direct push units include split-spoon samplers, solid barrel samplers, and thin-wall samplers.

Split-spoon samplers used with direct push units are similar to those used with drill rigs. These samplers may be opened after soil is retrieved and a soil sample may be collected from the open split-spoon using one of the sample collection and preservation methods listed above.

Thin-wall samplers are most commonly used to collect soil that will be analyzed for geotechnical parameters including hydraulic conductivity and density. If a thin-wall sampler is used to collect soil samples for offsite chemical analysis, the tube is usually capped after the soil is retrieved, cooled to 4°C, and sent to the lab.

Solid soil retrieval devices such as solid barrel samplers are most commonly used in combination with an internal liner. When soil is retrieved from the subsurface, the liner is removed from the barrel. Soil intended for analysis on site may be extruded from the liner and analyzed. If the soil

will be sent to a laboratory for chemical analysis (especially VOC analysis), it is recommended that the liner be capped immediately after retrieving the soil sample<sup>x-2</sup>.

#### **Z.5.4 Collecting soil samples from the ground surface and shallow subsurface**

Although most releases investigated by the storage tank program occurred below grade, persons characterizing a site may occasionally have to collect soil samples in the vicinity of a surface release or collect samples from another shallow, exposed, readily accessible surface. In these instances, the person collecting samples may collect samples directly using a volumetric sampling device. Alternatively, these persons may collect samples by using clean, decontaminated stainless steel or Teflon® spoons and transfer the soil from the spoon to the 40 ml vial or bulk sample container.

When using spoons to collect soil samples from shallow, exposed locations, it is recommended that the following procedures be followed:

1. Determine the location from which a sample will be collected.
2. Remove leaves, grass, and other debris on the ground surface prior to sample collection.
3. Scrape the surface of the desired sampling location with a clean shovel or other device to obtain soil from a location not likely to be impacted by cross contamination;
4. Don clean latex gloves prior to collecting the sample.
5. Transfer soil to the appropriate container using a volumetric sampler, stainless steel, or Teflon® spoon.
6. Label the sample container.
7. Record the location from which the sample was collected and any other characteristics of that location (e.g. soil texture, color, petroleum staining, odor, PID/FID readings, etc.).
8. Decontaminate stainless steel or Teflon® spoons before collecting another sample.

### **Z.6 Decontamination**

Soil samples collected as part of UST closure and release response and corrective action must be collected from discrete locations in order to provide the type of information needed to support the decision making process. A key element of collecting samples from discrete locations is preventing contaminants from one sample collection location from being present in samples collected at later times from other locations. In order to prevent cross contamination of this sort, sampling equipment must be decontaminated prior to the collection of each sample if the sampling

<sup>x-2</sup> U.S. EPA. 1997. **Expedited Site Assessment Tools for Underground Storage Tank Sites, A Guide for Regulators.** EPA 510-B-97-001.

equipment used is not disposable. General field decontamination procedures for non-disposable sampling equipment are as follows:

1. Place the sample collection device in a low phosphate detergent solution and scrub the device with a stiff brush
2. Rinse the sample collection device with de-ionized water, and
3. Air dry the sample collection device,

All field instruments should be decontaminated in accordance with the manufacturer's instructions. At a minimum, instrument probes should be rinsed in de-ionized water after each use.

## **Z.7 Screening Soil Samples with a PID/FID**

Field screening devices such as flame and photoionization detectors should be used to screen soil samples in the field to determine which samples to send to a lab for analysis. When soil samples will be screened, DEQ recommends that the sample containers required for laboratory analysis be filled first. After the containers have been filled in accordance with the analytical method requirements, a second aliquot of the sample should be placed in a different container (e.g. sealable plastic bag), allowed to equilibrate, and screened with a PID/FID.

A procedure that persons may use when screening soil samples in the field with a PID/FID is as follows:

1. Collect the sample from desired location.
2. Split the sample and place one of the split samples in a sample container that is appropriate for the lab analysis to be performed. Subsequently, place the second part of the sample into a sealable plastic bag.
3. Allow the soil in the plastic bag to equilibrate for a specified length of time. Each sample placed in a plastic bag should be allowed to equilibrate for the same length of time. Do not place this soil in a cooler.
4. After the specified length of time has elapsed, open the seal on the plastic bag (as little as necessary) and insert the PID/FID probe.
5. Record the PID/FID reading.

Persons using field screening instruments such as a PID or FID are expected to calibrate the instrument immediately prior to use in accordance with the manufacturer's specifications.

## **Z.8 Sample Chain of Custody**

Once a sample is collected, precautions must be taken to preserve the sample's chemical and physical integrity during transport to the lab and storage prior to analysis. Persons collecting samples are responsible for documenting that the integrity of samples has been maintained during



transport to and storage at the lab. An important component of sample integrity is ensuring that soil sample holding times are not exceeded. There is a 48-hour holding time for non-preserved soil samples that will be analyzed for volatile organics. Given the narrow holding time limits on certain soil samples, DEQ recommends that persons collecting samples document sample integrity by using a chain-of-custody for all samples.

## **Z.9 Ground Water Sampling**

Samples of environmental media are often collected at storage tank sites during the processes of closing storage tanks, investigating and confirming releases, characterizing sites following a release, and performing corrective actions. The DEQ Storage Tank Program relies on information generated from sample analyses to determine appropriate courses of action for individual sites. Information from samples must be of a sufficient and known quality to support the decision making process.

The procedures discussed below are intended to provide general guidelines for persons collecting ground water samples that are expected to meet the data quality objectives needed for release response and corrective action at leaking storage tank sites. The use of these procedures is not required by the DEQ Storage Tank Program and persons collecting samples are encouraged to develop and use sample collection procedures that best account for the intrinsic conditions of the site that they are investigating. When sample collection procedures used at a site differ from those described here, DEQ expects these procedures to be outlined in the report containing the analytical results for samples collected using those procedures.

## **Z.10 Data Quality Objectives – Ground Water Sampling**

The objectives for monitoring or evaluating ground water quality at storage tank sites may vary depending upon the activity being performed at the site. Persons closing storage tanks are required to collect samples from locations most likely to be impacted if a release has occurred. Although soil samples are more commonly collected than water samples during the closure process, persons may collect ground water samples if ground water would accurately reflect whether a release occurred at the site. When ground water samples are collected during tank closure, the objective is one of detection: Has a release occurred? Persons finding petroleum constituents in excess of 1 mg/l TPH and/or any regulated substances above the detection limit in water samples collected during closure are required to report these results to DEQ.

Detection is also the data quality objective for water samples collected during the release investigation and confirmation process. The concentration of any regulated substance found in the ground water and stored in tanks at the site will be considered by DEQ as evidence of a release.

Ground water samples collected during the site characterization process are usually collected to assess conditions at the site. This ground water data is needed to determine the severity and extent

of ground water contamination at the site and support the risk-based decision making process. Ground water data obtained during the site characterization process also may be needed to evaluate potential remedial alternatives for the site and support preliminary or conceptual designs for the recommended remedial alternative.

If corrective action is needed, ground water samples may be collected during the corrective action plan development phase to provide additional information needed to design a remediation system for the site. Once corrective actions are implemented at a site, ground water and/or other media may be analyzed to determine the effectiveness of the corrective action and the time that corrective actions may be terminated. If corrective action is not proceeding as expected, samples also may be collected and analyzed for the purpose of modifying the corrective action.

The purposes of collecting ground water samples and the data needs required at the time of UST closure, site characterization, and corrective action may be different. Despite the different requirements for samples collected during these different phases, several fundamental objectives appear to be present regardless of the time or phase of activity. The first fundamental objective involves the avoidance of gross errors (Barcelona, 1993). Within this context, gross errors are the collection of false negative data due to poor sampling techniques or collecting samples from inappropriate locations.

A second fundamental need regardless of the phase within which samples are collected involves the collection of a complete set of data to support the decision making process. Regardless of the phase of work, a project objective is to minimize sampling costs by avoiding redundancy in the data collection process.

## **Z.11 Measuring Static Water Level**

When ground water samples are collected from a site, DEQ generally expects the person collecting the samples to measure the static water level in all wells as part of the sampling event. Static water level in a well must be measured before the well is purged or sampled. Water level measurements in the wells at a site should be obtained within as short a period of time as possible. In all cases unless agreed to by the consultant, RP, and DEQ Case Manager, static water levels for all wells at a site should be determined within the same day.

Devices used to measure static water level in each well must be decontaminated between each well. In order to further reduce the probability of cross contamination, static water level measurements should, to the extent possible, be collected in order from the least contaminated well to the most contaminated well. If contamination levels are not known, it is recommended that static water levels in the probable upgradient wells and wells most distant from probable contaminant sources be measured prior to measuring static water levels in wells at or in close proximity to probable/suspected sources.

The first step in determining ground water elevations at a site is to measure the casing elevation of each monitoring well. Although it is recommended, DEQ does not require persons to determine

well elevations using established USGS benchmark elevations. In all cases, the correct relative elevation of all wells at the site must be determined so that the relationship between ground water elevations in individual wells may be evaluated.

Any number of methods or devices may be used to measure static water levels at a site. In order to promote consistency, it is recommended that the same device or method be used to measure static water levels in all wells. If more than one measuring method must be used, the person collecting the information must calibrate both instruments or methods in the same well to ensure that the same water level measurements are obtained by both instruments or methods.

### **Z.11.1 Electronic Water Level Indicator**

1. Lower the decontaminated probe into the well until the instrument indicates that the water column or a layer of non-aqueous phase liquid has been reached.
2. Raise and lower the probe in and out of the water until satisfied that the water level indicator is providing a reliable water level reading.
3. Read the measurement on the tape to the nearest .01 foot against the top of the casing or other reference elevation on the well.
4. Record the measurement taken as "depth to water" for that well.
5. Decontaminate the probe and tape using a detergent solution and deionized water

### **Z.11.2 Tape Measure and Indicator substance**

1. Coat the lower two to three feet of the tape with the indicator substance.
2. Lower tape several inches into the water column, then wait for at least five seconds or other period of time as recommended by the manufacturer of the indicator substance.
3. Read the tape measurement to the nearest 1/16 inch against the top of the casing or other reference elevation on the well and record this measurement in the field notebook.
4. Withdraw the tape from the well and record the measurement showing the interface between the wetted and dry portions of the tape.
5. Subtract the measurement showing the interface between the wetted and dry portions of the tape (step 4) from the total depth measurement (step 3) and record as the depth to water.
6. Decontaminate the tape using a detergent solution and deionized water

## **Z.12 Measuring Immiscible Layers**

Petroleum products are immiscible with and less dense than water. When significant quantities of petroleum are released to the environment, a layer of petroleum (a non aqueous phase liquid) may form on top of the ground water. The first time that wells are gauged and sampled at a site, DEQ expects the person collecting the samples to check for the presence of non-aqueous phase liquids in all monitoring wells at the site. During subsequent monitoring events, the person collecting

samples should at a minimum, monitor wells in the source area and all wells showing historic contamination for non-aqueous phase liquids.

The process of determining if immiscible layers are present in a well and measuring the thickness of immiscible layers is usually performed by using an interface probe that is sensitive to both water and non-aqueous phase liquids or using a tape measure that has been coated with a water and non-water indicator substance.

NOTE: Bailers are generally inappropriate for determining free product thickness in wells.

### **Z.12.1 Interface Probe**

One of the more common ways to measure for the presence of a non aqueous phase liquid is to use an interface probe that is sensitive to both water and non-aqueous phase liquids. Persons measuring immiscible layers with an interface probe should use the probe in accordance with the manufacturer's instructions. In general, the procedure for measuring immiscible layers with an interface probe is as follows:

1. Lower the decontaminated probe into the well until the instrument indicates that a liquid has been reached.
2. Determine the type of liquid that has been reached in accordance with the manufacturer's instructions for the interface probe used.
3. Raise and lower the probe in and out of the liquid until satisfied that the liquid level indicator is providing a reliable reading of the air/liquid interface in the well.
4. Read the measurement on the tape to the nearest .01 foot against the top of the casing or other reference elevation on the well.
5. If the interface probe indicates that there is light non-aqueous phase layer, record the measurement taken as "depth to product".
6. Lower the probe until the instrument indicates that the product/water interface has been reached. Raise and lower the probe until satisfied that the indicator is providing a reliable reading of the product/water interface.
7. Read the measurement on the tape to the nearest .01 feet against the top of the casing or other reference elevation on the well and record the measurement as "the depth to water."
8. Retrieve the probe from the well.
9. Decontaminate the probe using a detergent solution and deionized water.

### **Z.12.2 Tape Measure and Indicator Substance**

Although not as convenient as interface probes, a tape measure coated with an indicator substance may be used to determine if a layer of light non-aqueous phase liquid (LNAPL) is present in a well. The general procedure for determining the presence and measuring the thickness of a well is as follows:

1. Coat the lower two to three feet of the tape with the indicator substance.
2. Lower the coated end of the tape into the well until the tape reaches the uppermost liquid layer. Lower the tape several more inches into the liquid, then wait for at least five seconds or other period of time as recommended by the manufacturer of the indicator substance.
3. Prior to moving the tape, read and record the tape measurement to the nearest 1/16 inch against the top of the casing or other reference elevation on the well.
4. Withdraw the tape from the well and determine if there is an immiscible phase present in the well in accordance with instructions provided by the manufacturer of the indicator substance.
5. If no non-aqueous phase layer is present, record the measurement showing the interface between the wetted and dry portions of the tape.
6. Subtract the measurement showing the interface between the wetted and dry portions of the tape (step 5) from the total depth measurement (step 3). This is the depth to water in this well. go to step 10
7. If a non-aqueous phase layer is present, record the measurements showing: a. the interface between the air and non-aqueous phase liquid; and b. the interface between the non-aqueous phase liquid layer and the water.
8. Subtract the measurement showing the interface between the LNAPL and the air (7a) from the depth to water measurement in step 3. This is the depth to non-aqueous phase liquid in the well.
9. Subtract the measurement showing the interface between the LNAPL and the water (7b) from the depth to water measurement in step 7. This is the "uncorrected depth to water".
10. Decontaminate the tape using a detergent solution and deionized water.

## **Z.13 Sampling Immiscible Layers**

Depending upon site-specific conditions and data needs related to characterizing the site or designing a remediation system, the RP may need to collect samples from a LNAPL layer at a site. LNAPL layers may vary within a continuum from a barely measurable thickness to many feet. Procedures for sampling LNAPL layers may, however, vary due to a combination of product thickness, sampling equipment, and site specific data needs. LNAPL sampling procedures below outline processes for collecting samples from wells where the LNAPL layer is less than one foot in thickness and greater than one foot in thickness.

### **Z.13.1 Immiscible layers < 1 foot thick in well**

1. Determine the depth to the light non-aqueous phase liquid (LNAPL; see procedure above)
2. Slowly lower a bailer (a top loading bailer is recommended) into the well until the top of the bailer is approximately in the middle of the LNAPL layer in the well.
3. After approximately 5 seconds, remove the bailer from the well.

4. If the bailer contains only the non-aqueous phase liquid, pour this liquid into the sample container(s)
5. If the bailer contains a mixture of water and LNAPL, allow the liquids to separate. Next, drain the water into an appropriate container, then fill the sample container(s) with the LNAPL.

#### **Z.13.2 Immiscible layers > 1 foot thick in well**

1. Determine the depth to the light non-aqueous phase liquid (LNAPL; see procedure above)
2. Slowly lower a bailer (a top loading bailer is recommended) into the well so that the bailer is only in LNAPL layer and not in the water (if possible).
3. After approximately 5 seconds, remove the bailer from the well.
4. If the bailer contains only the non-aqueous phase liquid, pour this liquid into the sample container(s)
5. If the bailer contains a mixture of water and LNAPL, allow the liquids to separate. Next, drain the water into an appropriate container, then fill the sample container(s) with the LNAPL.

### **Z.14 Determining the Water Table Elevation when a LNAPL Layer is Present**

Unless otherwise agreed to by the DEQ Case Manager, DEQ expects ground water data for every ground water sampling event. Persons gauging ground water at a site must be cognizant of the effects that a layer of light non-aqueous phase liquids can have on the water table. A layer of non-aqueous phase liquid on top of the water depresses the water table and the interface between the water and non-aqueous phase liquid observed in the well is actually below the real water table. In order to determine the actual elevation of the water table, the responsible person or his consultant must calculate the distance that the water table is depressed. The procedure for determining the actual water table when a layer of light non-aqueous phase liquid is present is as follows:

$$DTW_c = DTW_o - (PT * p_o)$$

where:

- DTW<sub>c</sub> = depth to water (feet)
- DTW<sub>o</sub> = measured depth to the lnapl/water interface (feet)
- PT = thickness of LNAPL layer (feet)
- p<sub>o</sub> = density of LNAPL (g/ml)

<b>Table Z.1. Densities of Selected Petroleum Products</b>	
<b>Product</b>	<b>Density (g/ml)</b>
Gasoline	.729
Diesel fuel	.827
Kerosene	.839
JP-5 (No. 5 Jet fuel)	.844
No. 2 fuel oil	.866
No. 4 fuel oil	.904
No. 6 fuel oil (Bunker C)	.974
Product densities taken from: EPA. 1996. <b>How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites: A Guide for State Regulators.</b> EPA 510-R-96-001.	

#### Example Z- 1. Correcting water table elevation when a LNAPL layer is present

The distance from the well head to the LNAPL /air interface is 10 feet. The LNAPL/water interface is measured at 15 feet. The elevation of the top of the well casing is 100 feet above sea level. The product released is gasoline (assumed density .73 g/ml). What is the actual hydraulic head in this well?

To obtain a hydraulic head that is corrected for free product:

$$DTW_c = DTW_o - (PT * p_o)$$

Where: DTW<sub>c</sub> = depth to water (feet)  
 DTW<sub>o</sub> = measured depth to the LNAPL/water interface (feet)  
 PT = thickness of LNAPL layer (feet)  
 p<sub>o</sub> = density of LNAPL (g/ml)

solution:

$$DTW_c = 15 \text{ feet} - (5 \text{ feet} * .73)$$

$$DTW_c = 15 \text{ feet} - 3.65 \text{ feet}$$

$$DTW_c = 11.35 \text{ feet}$$

$$\text{Water table elevation} = \text{elevation of casing} - DTW_c$$

$$\text{Water table elevation} = 100 \text{ feet} - 11.35 \text{ feet}$$

$$\text{Water table elevation} = 88.65 \text{ feet}$$

## Z.15 Well Purging

The goal of ground water sampling is to determine the conditions that are present in the ground water at the site. Water that is present in a monitoring well, especially water in the upper part of the casing may not be representative of water in the aquifer. Volatile constituents in the water may

have been lost to the headspace in the well and gases within the casing may change the chemistry of the water in the upper part of the casing.

In order to obtain samples that are representative of ground water at the site, water must be purged from the well until water from the formation has been brought into the well. Persons collecting samples from wells may decide the volume of water to be purged from a well by: (1) removing a specified volume of water from the well (usually three or more well volumes); (2) purging water until certain field parameters (e.g. water temperature and conductivity) stabilize; or (3) some other method that indicates the water in the well is representative of water in the aquifer.

Volatile organic compounds are present at many leaking storage tank sites. Rapid purge rates may cause water recharging the well to cascade down the interior of the casing thereby, aerating the water and causing a loss of volatile compounds. Regardless of the combination of well and formation characteristics encountered at a site, purge rates should be sufficiently low to minimize the loss of volatile constituents.

As with the measurement of static water levels, wells should be purged in the order of least contaminated to most contaminated. If contamination levels are not known, DEQ recommends that wells upgradient of the source(s) be purged first followed by the wells that are downgradient of the source. Lastly, the wells that are in the immediate vicinity of the source should be purged.

NOTE: Purging in order from least to most contaminated is not necessary if dedicated or disposable purging or purging/sampling equipment is used.

#### **Z.15.1 Wells having a high recovery rate (wells that recover within one hour after purging)**

One of the more common methods used to determine the volume of water to remove from a well is to remove a specified volume of water from the well prior to sample collection. This approach typically involves the removal of three or more well volumes of water in order to ensure that the water in the well is from the formation.

Purging three well volumes with a bailer

1. Calculate the number of gallons needed to remove three well volumes of water. Record this data as three well volumes.
2. Lower the bailer to a point that is approximately half the distance between the water table and the bottom of the well screen.
3. Slowly purge three well volumes of water from the well
4. Allow the well to recharge
5. Collect the water sample(s)



### Purging three well volumes with a standard pump

1. Calculate the number of gallons needed to remove three well volumes of water. Record this data as three well volumes.
2. Slowly lower the pump to the center of the screened interval within the well.
3. Connect the power source and appropriate control devices to the pump.
4. Initiate well purging. During purging, minimize well drawdown. If drawdown is occurring, reduce the rate at which water is purged from the well.
5. Allow the well to recover.
6. Raise the pump to within one foot of the top of the water level within the well and collect the sample(s).

Persons purging water from wells may decide to base purge volumes on water quality indicator parameters including pH, oxidation-reduction potential, specific conductance, temperature, dissolved oxygen, and turbidity. This approach to well purging involves measuring one or more of these parameters during the purging process and collecting samples after the parameters of interest stabilize. According to Puls and Barcelona (1996), the typical order of stabilization is pH, temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity. Temperature and pH, while commonly used as purging indicators, are relatively insensitive in distinguishing between stagnant casing water and water from the formation. The frequency of measurement of the indicator parameters and the criteria to decide that the parameters are stabilized needs to consider pump flow rate and the precision of the monitoring instruments.

### **Z.15.2 Wells having a low recovery rate**

The following purging procedures apply to wells that take greater than one hour to recover after they have been purged dry or nearly dry.

#### purging using a bailer

1. Calculate the volume of water in the well and casing
2. Purge the well at a slow rate and try (if possible) to prevent the bailer from contacting the bottom of the well.
3. Purge the well until the well is almost dry
4. Record the volume of water removed from the well
5. Allow the well to recover

#### purging using a pump

1. Slowly lower the pump to the lower portion of the screened area of the well but do not lower the pump all the way to the bottom of the well
2. Start purging the well (a recommended maximum flow rate is 300 ml/minute (.1 gpm).
3. Purge the well until the water level in the well reaches the pump or the pump runs dry
4. Record the volume of water removed from the well.

$$\text{well volume} = [\Pi C^2 H + | (\Pi B^2 Hn - \Pi C^2 H) |] * 7.48 \text{ gallons/ft}^3$$

where:  $\Pi = 3.14$

C = radius of well casing in feet

H = height of water column in casing (feet)

B = radius of boring in feet

n = porosity of filter pack

### **Z.15.3 Low Flow Purging**

The most common ground water purging and sampling methods currently used involve the use of high-speed pumps or bailers to remove an established volume of water from the casing prior to sample collection. Unfortunately, these methods can cause adverse impacts on sample quality including turbidity and aeration of the water as the well is recharged. One way that persons collecting samples may use to try to reduce the adverse impacts on sample quality caused by the more traditional purging methods is to use low-flow purging. Low-flow purging refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen (Puls and Barcelona 1996, Puls and McCarthy 1993). The objective of low-flow purging is to purge water in a manner that minimizes stress (i.e. drawdown) to the system to the extent practical. Typical flow rates used in low-flow purging applications are on the order of .1 to .5 liters/minute. Water is purged until the desired indicator parameters stabilize.

The general procedure described by Karklins (1996a) for purging a water table well via a low-flow pump is:

1. Fasten the power cable and sample tubing at the top of the well and connect the power source, controller box, etc. to the pumping equipment.
2. Slowly lower the pump to the middle of the screened area (if the well is known to recharge slowly, lower the pump to the lower portion of the screened area, but not to the bottom of the well).
3. Connect the sample tubing to the water entry point of the closed flow-through cell
4. Set up and calibrate all instruments that will be used to calibrate the indicator parameters and place each probe into its respective port of the closed flow-through cell.
5. Set the pump controller to the desired purging rate (< .1 liter/minute).
6. Record the time that purging is initiated.
7. Monitor water levels during purging. If the well is in a high yield formation, the water level in the well should stabilize after the first few minutes of purging. If the water level continues to decline during purging, reduce the purging rate if possible.
8. Purge the well until the readings for the selected indicator parameters (e.g. specific conductivity, oxidation-reduction potential, dissolved oxygen, turbidity, etc.) have stabilized. A variation of  $\pm 10\%$  over three or more consecutive readings that are spaced at least 2 minutes apart or  $\frac{1}{2}$  well volumes apart.

## **Z.16 Quality Control Samples**

Samples collected from a site must be of sufficient quality to support the decisions that must be made about the site. Quality control may be of varying degrees of importance depending upon the intended use of the data. As a general rule, the DEQ Storage Tank Program will require field blanks and trip blanks for water samples collected during the Site Characterization Phase. Quality control samples may be required during other corrective action phases at the discretion of the Case Manager.

### **Z.16.1 Trip Blanks**

The purpose of trip blanks is to determine if the sample container, preservative, or transportation process may be introducing contaminants into the samples. Trip blanks consist of the appropriate sample containers and preservative that are filled with reagent grade water. These blanks are then placed in the cooler, taken into the field, and analyzed in the lab along with the other samples. The DEQ Storage Tank Program recommends that one trip blank be included per cooler. Trip blanks must be analyzed by the same laboratory that is analyzing the other samples and must be analyzed for the same parameters.

NOTE: Trip blanks do not need to be analyzed if all other samples are analyzed and the constituents of concern are below the detection limits in all other samples.

### **Z.16.2 Field Blanks**

Another type of quality control sample that the DEQ Storage Tank Program generally requires during the site characterization phase is field blanks. A field blank may also be called a sampling blank and the purpose of field blanks is to determine if the sampling procedure or environment may be introducing contaminants into the samples. Field blanks for water samples should be collected by placing reagent grade deionized water in the decontaminated sample collection device (e.g. bailer) and placing that sample in the appropriate sample container(s). Once the field blank is collected, the blank is placed in a cooler along with the other samples.

The DEQ recommends that field blanks be collected after collecting a sample from one of the more contaminated wells at the site. Typically, one field blank should be collected for every ten samples. The DEQ Case Manager, Responsible Person, and consultant may alter the number of blanks needed for a site based upon site-specific data requirements.

NOTE: Field blanks are not required if dedicated sampling equipment is used (i.e. the bailer is permanently left in the well) or disposable sampling equipment is used.

## **Z.17 Collecting Ground Water Samples**

Ground water samples collected during the release investigation and release response/corrective action processes will routinely be analyzed for volatile and/or semivolatile organic compounds. Ground water samples from leaking petroleum storage tank sites also may be analyzed for metals, nutrients, and/or parameters related to general water chemistry. When ground water will be analyzed, the order in which sample containers are filled or parameters are analyzed in the field is critical to obtaining information that is representative of actual site conditions. Persons collecting samples should, therefore, consider temporal effects on the parameters that they will be measuring.

The DEQ Storage Tank Program recommends that samples be collected and/or analyzed in the following order:

1. Samples to be analyzed in the field for general water chemistry (e.g. dissolved oxygen, pH, specific conductance).
2. Volatile organics
3. Semivolatile organics, nutrients, total organic carbon, total metals (these samples may be preserved, but they do not need to be filtered).
4. Dissolved metals (these samples must be filtered and preserved).

Most of the releases evaluated by Storage Tank Program staff involve petroleum products. The concentration of dissolved petroleum constituents in ground water near the source tends to be the greatest near the ground water surface. At distances from the source, some petroleum constituents, notably MTBE, tend to plunge beneath the ground water surface.

Persons collecting samples must take the characteristics of the released materials into consideration when determining the appropriate interval or location within the well to collect the sample. The DEQ Storage Tank Program makes risk-based corrective action decisions based upon the principle of reasonable maximum exposure. Persons collecting ground water samples should try to collect samples from the well depth where they expect the greatest concentration of dissolved constituents.

### **Z.17.1 Samples to be Analyzed for Volatile Organic Compounds (VOCs)**

Persons collecting samples that will be analyzed for volatile organic compounds (VOCs) should be cognizant of nearby sources of VOCs and, to the extent possible, attempt to minimize the contribution of contaminants from those sources. Persons collecting samples may wish to turn off nearby gasoline engines or try to collect samples upwind of engine exhaust.

Samples that will be analyzed for VOCs are usually preserved with an acid to discourage biodegradation. Persons collecting samples should ensure that the samples are preserved in accordance with the analytical method to be used.

When filling a sample container, the container should be tilted slightly from the vertical and a slow stream of water from the sampling device should be allowed to run down the inside wall of the sample container. The person collecting the sample should fill the container until the water forms a positive meniscus at the top of the container. The container should then be capped and turned upside down to determine if air bubbles are present in the container. If air bubbles are present, another sample should be collected and the first sample should be discarded. After a sample has been collected, the container should be labeled and immediately placed on ice.

### **Z.17.2 Samples to be Analyzed for Semivolatile Organic Compounds (SVOCs)**

Samples that will be analyzed for semivolatile organic compounds (SVOCs) must be preserved in accordance with the requirements for the analytical methods that will be used to analyze the samples. The person collecting samples for SVOCs should leave approximately 1/2 inch of air space in the sample bottle to allow for expansion of the sample.

Given the nature of semivolatile constituents, there is generally less concern with contaminants from other sources reaching and interfering with the sample that is collected. DEQ, however, recommends that persons collecting samples attempt minimize the contribution of contaminants from these extraneous sources to the extent possible.

### **Z.17.3 Metals**

Persons designing remediation systems that will treat ground water often must determine if dissolved metals in the ground water will adversely affect the proposed treatment system. Persons collecting samples that will be analyzed for dissolved metals must exercise care to minimize oxidation of the sample during filtering and handling. Aeration or oxidation of a sample may change the sample from a reduced state to an oxidized state and reduce dissolved metal concentrations. Common methods of ground water purging such as using high-speed pumps and bailers also may cause adverse impacts on sample quality. Bailers and high speed pumps often cause an increase in turbidity in the well. High turbidity results in the inclusion of otherwise immobile particles into the sample and this can lead to an overestimation of certain analytes such as metals. Ground water samples that will be analyzed for metals generally need to be filtered unless: (1) the samples will be analyzed for total instead of dissolved metals; (2) low-flow sampling procedures are used and three consecutive in-field turbidity readings are all  $\leq 5$  nephelometric turbidity units (NTUs) or (3) the DEQ Case Manager determines that sample filtration is not needed.

### **Z.17.4 Nutrients**

Information about nutrients may be valuable when evaluating natural or enhanced biodegradation at a site. Samples that will be analyzed for nutrients such as nitrate and phosphate may or may not need to be preserved depending upon the analytical method that will be used. In all instances, the

person collecting the samples must ensure that the samples are preserved and handled in accordance with standard procedures for the analytical method to be used.

### **Z.17.5 Parameters Related to General Water Chemistry**

Certain water quality parameters may be altered significantly when ground water is removed from a well and exposed to higher temperatures and oxygen. Water quality parameters that may be subject to significant change include specific conductance, pH, temperature, dissolved oxygen, and Eh (redox potential). When information about one or more of these parameters must be obtained, it is recommended that measurements be collected in-situ using a down-well probe or as part of a closed system. If this is not possible, the appropriate measurements must be taken immediately after a sample is collected.

### **Z.17.6 Temperature**

Temperature is one of the first parameters to stabilize when purging wells. Although temperature is not necessarily a reliable indicator that formation water has been reached, this parameter should be monitored due to its importance and effect on chemical and biochemical reaction rates.

1. Place the thermometer or probe into a closed flow-through cell or sample bottle and allow the purge water to continuously flow past the thermometer or probe. If a sample bottle is used, allow the bottle to overflow when taking the temperature reading.
2. Allow the thermometer or probe to equilibrate with the water for a minute or more, then record the temperature. Do not remove the thermometer or probe from the water when taking the reading.
3. Decontaminate the thermometer or probe and store the instrument appropriately.

### **Z.17.7 Specific Conductivity**

Specific conductivity is a measure of an aqueous solution's ability to conduct an electrical current. The ability to conduct electricity depends on the presence, concentration, and mobility of charged ionic species in the water (e.g.  $\text{Ca}^{2+}$ ,  $\text{Cl}^-$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ , etc.) and temperature of the water. Soluble inorganic compounds are usually good conductors.

Specific conductivity must be measured prior to pH unless a flow through cell is used. Specific conductivity is also a temperature sensitive measurement and the conductivity meter should be adjusted and calibrated in accordance with the manufacturer's instructions.

Karklins (1996a) provides the following general procedure for measuring specific conductivity:

1. Calibrate the conductivity instrument and probe against a standard solution (usually potassium chloride) in accordance with the manufacturer's instructions. It is preferable if

- this calibration is performed in the field immediately prior to sample collection and analysis.
2. If required, set the instrument to the anticipated range for measurement.
  - 3a. If the instrument automatically compensates for temperature, record the measurement as “field specific conductivity at 25°C.”
  - 3b. If the instrument does not automatically compensate for temperature, measure the temperature of the sample and adjust the instrument’s temperature setting to correspond with the sample temperature. Record the measurement as “field specific conductivity at 25°C.”
  - 3c. If the instrument cannot compensate for temperature, apply a correction factor as specified by the manufacturer or by using the following formula:  
$$\text{Specific conductivity @ 25°C} = \text{sample conductivity } \mu\text{mhos/cm} / \{1 + 0.0191(\text{sample temp in } ^\circ\text{C} - 25)\}$$
  4. Decontaminate the instrument and probe and store properly.

## **Z.17.8 pH**

pH is a measure of the concentration of hydrogen ions in an aqueous solution. The pH of ground water has a bearing on the chemical composition of constituents in that ground water and also may effect chemical reaction and biological rates in the ground water. The solubility of metals in water is also influenced by pH.

Karklins (1996a) provides the following general procedure for measuring pH:

1. Calibrate the pH instrument with pH calibration solutions that span the range of expected ground water pH values.
2. Place the calibrated pH probe into a closed flow-through cell and allow the purge water to continuously flow past the probe. If pH will be measured from a sample container, fill a container that will be used only for the purpose of measuring pH.
3. Allow the pH probe to equilibrate, then record the pH.
4. Clean and store the pH probe in accordance with the manufacturer’s instructions.

## **Z.17.9 Dissolved Oxygen**

Dissolved oxygen concentrations in water are affected by the chemical, physical, and biochemical activities occurring in the water. Dissolved oxygen concentrations can provide useful information about ground water contamination and the aerobic biodegradation of those contaminants. Dissolved oxygen readings taken from a probe inserted down the well may also help the investigator to evaluate or estimate the vertical contamination gradients within a well where the contaminants are subject to aerobic biodegradation.

Three primary methods used to measure dissolved oxygen in the field are: (1) the Winkler titration method; (2) the electrometric method (dissolved oxygen meter); and (3) colorimetric methods. The

dissolved oxygen meter may be the most convenient of the three methods to use for determining dissolved oxygen concentrations. Persons using dissolved oxygen meters should be aware that, to function properly, most dissolve oxygen probes require a continuous flow of water past the membrane while measurements are being taken (Karklins 1996a).

#### **Z.17.10      Oxidation-Reduction Potential (Eh)**

Oxidation-reduction reactions affect the chemistry of naturally occurring constituents and contaminants within ground water by causing a gain or loss of electrons. Redox reactions are of interest when monitoring ground water that has been contaminated by petroleum and other organic constituents. Under aerobic conditions, oxygen acts as an electron acceptor and the petroleum constituent (e.g. benzene) as an electron donor in the metabolic process used by microorganisms to break down the petroleum constituent. After the available oxygen has been metabolized by the microorganisms, the reactions usually switch to an anaerobic state where nitrate, ferric iron, sulfate, and carbon dioxide act as electron acceptors. Oxidation-reduction data can provide the investigator with information about biodegradation that is occurring within the aquifer.

Field measurements of Eh must be made in an air-tight flow-through cell or down the well. The water must not come into contact with the atmosphere while Eh is being measured (Karklins 1996b).

#### **Z.17.11      Turbidity**

Turbidity is a measure of the clarity of a water sample. Turbidity is caused by suspended and colloidal matter such as clay, silt, organic matter, and micro-organisms. According to Karklins (1996a), turbidity should be measured on the same day that the sample was collected and preferably in the field immediately after collection.



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## **APPENDIX AA**

### **Petroleum Product Chemistry**

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## **Appendix AA**

### **Petroleum Product Chemistry**

Most of the releases evaluated by the DEQ Storage Tank Program staff involve petroleum products. The purpose of this section is to provide information related to the chemistry of various petroleum products. Where appropriate, recommendations are also made about analytical methods for these products.

The DEQ staff members have also encountered releases of ethanol and antifreeze. Information about these non-petroleum products is also provided.

Staff and others referring to this section should be aware that a wide variety of petroleum products are often transported via the same vessels, pipelines, vehicles, etc. Transportation of petroleum products often introduces constituents from one type of petroleum product into the next one that is transported via the same system. As a result, it is quite possible to find small amounts of certain constituents (e.g. MTBE) in other petroleum products that would not otherwise contain this constituent. The DEQ Regional Case Managers should consider the possibility of cross contamination when evaluating releases of petroleum into the environment and the DEQ has the authority to direct RPs to obtain information about cross contaminants such as BTEX and MTBE should site-specific conditions and potential risks warrant the collection of this additional information.

#### **AA.1 Gasoline**

Gasoline is a blend of volatile hydrocarbons suitable for use in a spark-ignited internal combustion engine and having an octane number of at least 60 (Micromedex 1993). The boiling point for gasoline range constituents is from 40 to 200 degrees Celsius. This corresponds with hydrocarbons having alkane numbers from n-C4 to n-C12 with most constituents falling in the C5 to C10 range (Michigan DEQ 1999). Gasoline may contain over 200 individual petroleum-derived chemicals and is formulated for burn rate (octane number), volatility (for constant performance in hot and cold weather) and emission control (Cole 1994, Weisman 1998). When evaluating gasoline or other motor fuels, it is important to remember that motor fuels are manufactured to meet the property limits of the specifications and regulations, not to achieve a specific distribution of hydrocarbons by class and size (Chevron Products Company 1996). Thus, gasoline may vary considerably over time depending upon the refinery streams used and original crude oil source. The relative percentages the different hydrocarbon classes found in gasoline are as follows:

- 40 to 70% straight, branched, and cyclic alkanes (paraffins)
- <10% alkenes (olefins)
- 20 to 50% aromatics

According to EPA (1992), Paraffins are the largest class of chemicals associated with gasoline and often comprise greater than 65% of the gasoline. Paraffins are composed of chains of carbons that are singly-bonded to atoms of hydrogen (saturated hydrocarbons). The next major class of constituents found in gasoline is the aromatics. Aromatic constituents are those compounds whose structure includes a benzene ring. According to EPA (1992), aromatic constituents comprise about 25% of most gasolines. Olefins are usually the smallest group of hydrocarbon constituents in gasoline. Olefins consist of hydrocarbon chains that contain double or triple bonds (unsaturated hydrocarbons).

### AA.1.1 Gasoline Additives

Many constituents are added to gasoline to enhance the performance of the gasoline or provide certain characteristics that are not inherent in the gasoline (Chevron Products Company 1996). The general classes of gasoline additives are listed below.

<i>Oxidation Inhibitors (antioxidants)</i>	ortho-alkylated phenols p-phenylenediamine, aminophenols, 2,6-di-tert-butyl-p-cresol
<i>Anti-knock Compounds</i>	tetraethyl lead tetramethyl lead tertiary-butyl alcohol (TBA) methyl-tertiary butyl ether (MTBE) 2,2-4 trimethylpentane methylcyclopentadienyl manganese tricarbonyl (MMT)
<i>Corrosion Inhibitors</i>	carboxylic acids fatty acid amines sulfonates
<i>Lead Scavengers</i>	ethylene dibromide ethylene dichloride (dichloroethane, DCA)
<i>detergents</i>	aminohydroxy amide

sources: (Chevron Products Company 1996, Potter and Simmons 1998).

### **AA.1.2        Leaded Gasoline**

The lead alkyl compounds tetraethyl lead and tetramethyl lead were used as anti-knock compounds in gasoline from the 1920s to the 1980s. According to Chevron Products Company (1996), the average concentration of lead in gasoline was gradually increased until it reached a maximum of about 2.5 grams per gallon in the late 1960s.

### **AA.1.3        Constituents of Concern in Gasoline**

Given their combination of toxicity, solubility, and mobility, the BTEX constituents receive much of the attention when gasoline is released into the environment. In recent years, oxygenates such as MTBE have received increasing attention due to their high solubility and mobility in ground water. Gasolines manufactured prior to 1990 may have contained tetraethyl or tetramethyl lead and the accompanying lead scavengers. Gasoline also may contain the smaller and lighter PAHs such as naphthalene, anthracene, benzo(b)fluoranthene, and fluoranthene. Typical concentrations of the primary constituents of concern in gasoline are as follows:

Benzene	2 to 3% with a maximum of about 7% (WHO 1989)
Toluene	4 to 7% (Cole 1994)
Xylenes	6 to 8% (Cole 1994)
Naphthalenes	.05 to .5% by weight (Heath et al. 1993)
Anthracene	1.55 to 1.84% by volume (Heath et al. 1993)
Benzo(b)fluoranthene	3.9% by volume (Heath et al. 1993)
Fluoranthene	1.84% by volume (Heath et al. 1993)
MTBE	10% maximum (WHO 1989)
	Up to 15% by volume (Ellis and Gavas 1996, EPA 1998)
n-hexane	11 to 13 % by weight (Cole 1994)

#### **AA.1.3.1        BTEX and MTBE**

Given the toxicity and mobility of the BTEX constituents and the mobility, potential toxicity, and aesthetic effects of MTBE, these constituents are primary constituents of concern at most gasoline release sites. These constituents usually can be detected and quantified using the same analyses. Persons interested in receiving information about MTBE in a sample should request that the lab provide this information.



The increased interest in MTBE and other oxygenates has prompted many laboratories to expand existing EPA analytical methods used for volatile organic constituents including Methods 8021B, and 8260B. According to Rhodes and Verstuyft, these commonly used EPA methods were neither developed nor validated for alcohols and ethers. This lack of performance data has resulted in questions about the reliability of these methods to accurately measure one or more of the alcohols and/or ethers.

### **Method 8021B**

Method 8021B is a GC/PID method that is selective for aromatic compounds including the commonly targeted BTEX constituents. MTBE also can be detected by this method. According to Hartman (1997) and Rhodes and Verstuyft, several alkanes elute close to MTBE and may result in false positives for MTBE or reported MTBE concentrations that are greater than the true MTBE concentration. This problem of MTBE co-eluting with several other constituents is further compounded by laboratories that compress the “run time” for 8021B from 20 minutes to less than 10 minutes (Hartman 1997). According to Hartman (1997), the problems with co-elution are greatest for soil vapor and soil samples although these problems also may be significant for water samples. For additional information on Method 8021B, see EPA SW846.

NOTE: EPA methods Methods 602 and 502.3 are water methods and similar to 8021B

### **Method 8260B**

According to Rhodes and Verstuyft, Method 8260B is a GC/MS method that is highly selective and provides a unique pattern (i.e. the mass spectrum) for any volatile organic compound. This method, therefore, is not only able to quantify MTBE but is able to distinguish between MTBE and the co-eluting alkanes because the masses of these compounds are different.

NOTE: EPA Wastewater and drinking water methods that are similar to 8260B are Methods 624 and 524.2, respectively.

## AA.1.3.2 Petroleum Hydrocarbons (TPH)

Persons closing regulated storage tanks containing gasoline are required to collect and analyze samples for TPH. The most appropriate TPH methods to use for gasoline range constituents are EPA Method 8015B for Gasoline Range Constituents, the California Method, and the Wisconsin DNR Method for Gasoline Range constituents.

## AA.1.3.3 Lead Compounds and Lead Scavengers

EPA methods do not mention the appropriate analysis to use for tetraethyl or tetramethyl lead. EPA Method 8270C can be used to analyze samples for these compounds. If information is needed about the organo-lead compounds, the DEQ recommends that the RP and/or consultant discuss this with the lab and determine the most appropriate method.

EPA Method 8260B may be used to analyze samples for the lead scavengers ethylene dibromide (a.k.a. 1,2-dibromomethane) and ethylene dichloride (a.k.a. 1,2-dichloroethane, 1,2-DCA). Persons analyzing samples for these lead scavengers must be cognizant of the fact the mere presence of these constituents at a site does not prove a release of leaded gasoline. Ethylene dibromide was widely used during the 1970s and early 1980s as a pesticide (fumigant) to protect fruits and vegetables from insects and nematodes (Michigan DEQ 1999 and Howard 1997). Ethylene dichloride, more commonly known as 1,2-DCA, is used as a chemical intermediate in the production of vinyl chlorides, a cleaning solvent, a diluent for pesticides, and in paints and adhesives (Michigan DEQ 1999, Drury and Hammons 1979, and Khan and Hughes 1979). The presence of this constituent in ground water also may be the result of biochemical breakdown of other chlorinated solvents such as trichloroethane (TCA).

#### AA.1.3.4 PAHs

The DEQ Storage Tank Program usually does not require that samples from gasoline release sites be analyzed for PAHs. If the DEQ Regional Case Manager believes that site-specific conditions and potential risks warrant this information, samples may be analyzed using EPA Methods 8270C, 8100, 8310, 610, and 625.

## **AA.2 Kerosene**

### **AA.2.1 Uses and General Information**

Kerosene is the term used to refer to the fraction of hydrocarbons removed during the distillation of petroleum at temperatures ranging from 175 to 330 degrees Celsius (Einhorn et al 1992). Fuel oil #1, jet fuel #1, and diesel #1 are basically the same products as kerosene except for end use and additives (ATSDR 1993). Fuel oil #1 (kerosene) is a light distillate intended for use in vaporizing type burners where the oil is converted to a vapor by contact with radiation or a heated surface (Curl and O'Donnell 1977). Kerosene range products are also used as jet engine fuels, illuminants, heating oils, and a fuels for internal combustion engines (WHO 1989).

Middle distillates such as kerosene generally contain hydrocarbons in the range of C9 through C20 (Irwin et al 1997). According to Sullivan and Johnson (1993), kerosene is composed primarily of hydrocarbons in the C11 to C13 range. Dimethylnaphthalenes, anthracene, n-dodecane, and n-tetradecane are chemical indicators for kerosene and diesel fuel (Thomas and Joseph 1991). Aromatics usually comprise 10 to 20 percent of the product depending upon the source of the crude oil (Irwin et al 1997). The boiling range of kerosene is well above that for benzene and the benzene concentration in kerosene is usually less than .02 percent (Irwin et al 1997).

## **AA.2.2        Constituents of Concern in Kerosene**

### AA.2.2.1        Petroleum Hydrocarbons (TPH)

Samples collected at kerosene release sites routinely will be analyzed for TPH. The dominant hydrocarbon compounds present in kerosene are better detected by the diesel range analyses than by the gasoline range analyses. The recommended analyses for TPH are GC based diesel range methods such as EPA Method 8015 for diesel range constituents, the California Method for diesel range constituents, and the Wisconsin DNR Method for diesel range constituents.

### AA.2.2.2        PAHs

The lighter PAHs such as the naphthalenes and anthracene are present in kerosene and information about PAH concentrations is important when assessing risks from a kerosene release. EPA Methods 8270C, 8100, 8310, 610, and 625 may be used to analyze samples for PAHs.

### AA.2.2.3        BTEX

Kerosene may contain small amounts of the BTEX constituents. The DEQ Regional Case Manager has the option of requiring BTEX if this information is believed necessary to evaluate risks at a site. In most instances, Case Managers will probably require BTEX analyses when ingestion of contaminated ground water is a pathway of concern at a site.

### AA.2.2.4        MTBE

MTBE is not an additive of kerosene. This constituent may, however, be found in small concentrations in petroleum products other than gasoline by virtue of multiple products being transported in the same pipelines and trucks. Given the mobility of MTBE, the Case Manager has the authority to require persons to analyze samples for this constituent should site conditions and potential receptors warrant this information.

NOTE: Case Managers may wish to obtain information about MTBE when a potable water supply well may be impacted by the release.

## AA.3 Jet Fuels

Many commercial jet fuels have basically the same composition as kerosene, but are under more stringent specifications than those for kerosene. Kerosene range fuels were originally chosen instead of gasoline to power the first jet aircraft due to the greater availability of kerosene than gasoline during World War II (Irwin et al 1997 and WHO 1989). Today, jet fuels have evolved to meet the specific needs required by air services. Table AA.1 below lists the major jet fuels and their general uses and characteristics.

### AA.3.1 Jet A

Jet fuel A is a petroleum distillate blended from kerosene fractions that is used for commercial and general aviation. An analysis of fresh Jet A performed by WHO (1989) indicated that paraffins made up approximately 58 percent of the fuel and aromatic hydrocarbons comprised approximately 33 percent of the fuel. Of the paraffin compounds, decane and undecane comprised 16.5 and 36 percent of the fuel, respectively.

Kerosene based fuels such as Jet A normally have a boiling range well above the boiling point for benzene. The benzene concentration in Jet A is usually below .02 percent (WHO 1989). Aromatic compounds of concern in Jet A include toluene, alkylbenzenes, naphthalene, and PAHs.

Table. AA.1. Jet Fuels	
JP-1	Kerosene
JP-4	U.S. Air Force wide cut aviation fuel comprised of 65% gasoline fraction and 35% kerosene fraction.
JP-5	Specially refined kerosene with a high flash point. The naval equivalent of JP-4, but having a higher flash point and lower volatility than JP-4 in order to minimize vapor exposure to personnel and reduce fire risk in enclosed spaces below decks (Landis et al 1993 and WHO 1989).
JP-6	A higher kerosene cut than JP-4 with fewer impurities
JP-7	A special kerosene having a high flash point used in advanced supersonic aircraft.
JP-8	A kerosene modeled on Jet A-1 that is used for new military aircraft.
Jet Fuel A	A petroleum distillate blended from kerosene fractions and used in civil aviation. This is the operational fuel for commercial turboprop and turbojet aircraft in the U.S.
Jet Fuel A – 1	A petroleum distillate blended from kerosene fractions and used in civil aviation. Jet A-1 is similar to Jet A except for a lower freezing point.
Jet Fuel B	A wide-boiling range petroleum distillate blended from gasoline and kerosene fractions. Operational fuel for U.S. and NATO military aircraft and many commercial turboprop and turbojet aircraft.

### AA.3.2      JP-4

JP-4 is a “wide-cut” aviation turbine fuel made by blending kerosene and gasoline fractions in a 35 to 65 ratio. Most alkane compounds in JP-4 have carbon ranges from 4 to 14 (Stelljes and Watkin 1993). According to Landis et al (1993) and Irwin et al (1997), JP-4 is the standard fuel of the U.S. Air Force and constitutes approximately 85 percent of the turbine fuels used by the Department of Defense (Stelljes and Watkin 1993).

Paraffins and cycloparaffins are the major components and may comprise up to 90 percent of JP-4 by volume (79% by weight, ATSDR 1995). Aromatic compounds make up 10 to 25 percent of JP-4 by volume. Wide cut jet fuels such as JP-4 include gasoline range constituents and, therefore, will usually contain more benzene than the kerosene based jet fuels. According to WHO (1989), the benzene concentration in JP-4 may be as high as .5 percent. ATSDR 1995 reports that the total BTEX concentration in JP-4 is usually less than 2 percent by weight while BTEX constituents in JP-4 products analyzed by Stelljes and Watkin (1993) and Harper et al (1993) made up to 4.5 percent of the fuel by weight.

PAHs are present in JP-4, however, the lower boiling points and greater gasoline fraction in this fuel tends to minimize PAHs present in the fuel. Naphthalene and alkyl naphthalenes reportedly comprise approximately 3 percent of JP-4 (ATSDR 1995).

### AA.3.3      JP-5

JP-5 is a form of number 1 fuel oil (U.S. Coast Guard 1986) and is considered to be the naval equivalent of JP-4 (Landis et al 1993). The different service needs by the navy led to the development of JP-5, a 60 degree Celsius minimum flash point, kerosene based fuel for use in shipboard service (WHO 1989). Overall, JP-5 is less volatile and has a higher flash point than does JP-4 in order to minimize vapor exposure to personnel and reduce the risk of fire in enclosed areas below decks.

JP-5 is a mixture of hydrocarbons that is similar to refined kerosene. The predominant constituents are hydrocarbon compounds having from 9 to 16 carbon atoms (Irwin et al 1997). Alkanes and cycloalkanes (paraffins) reportedly comprise approximately 75 to 90 percent of JP-5 (Irwin et al 1997).

### AA.3.4      JP-7

According to the Michigan DEQ (1999), JP-7 is made by blending kerosene distillates to produce a fuel containing a maximum of five percent aromatics by volume and a maximum of .1 percent sulfur by weight. A sample of JP-7 contained approximately 97.4 percent C10 to C17 alkanes, .4 percent C10 to C11 cycloalkanes, 1.6 percent C10 to C12 alkylbenzenes, and .6 percent C10 to C11 naphthalenes (Michigan DEQ 1999).

### AA.3.5        Constituents of Concern in Jet Fuels

#### AA.3.5.1        Petroleum Hydrocarbons (TPH)

Samples collected at jet fuel release sites routinely will be analyzed for TPH. Persons analyzing samples for TPH must consider the primary or dominant hydrocarbons present in the type of jet fuel released at the site. Most jet fuels are kerosene based and the petroleum compounds present in these fuels are better detected by the diesel range analyses than by the gasoline range analyses. When the fuel of concern is a kerosene based jet fuel, the recommended analyses for TPH are GC based diesel range methods such as EPA Method 8015 for diesel range constituents, the California Method for diesel range constituents, and the Wisconsin DNR Method for diesel range constituents.

JP-4 is reportedly composed of a wider range of compounds than are the other jet fuels and this product is prepared by blending gasoline and kerosene in a 65 to 35 ratio. The most appropriate TPH analyses to use for JP-4 are the gasoline range GC analyses such as EPA Method 8015B for Gasoline Range Constituents, the California Method, and the Wisconsin DNR Method for Gasoline Range constituents.

#### AA.3.5.2        PAHs

The lighter PAHs such as the naphthalenes are present in jet fuels and information about PAH concentrations is important when assessing risks from a jet fuel release. EPA Methods 8270B, 8100, 8310, 610, and 625 may be used to analyze samples for PAHs.

#### AA.3.5.3        BTEX

The kerosene based jet fuels may contain small amounts of the BTEX constituents and JP-4 may contain a larger percentage of these constituents. The DEQ Regional Case Manager has the option of requiring BTEX if this information is believed necessary to evaluate risks at a site. In most instances, Case Managers will probably require BTEX analyses when ingestion of contaminated ground water is a pathway of concern at a site.

#### AA.3.5.4        MTBE

MTBE is not intentionally added to jet fuels. This constituent may, however, be found in small concentrations in petroleum products other than gasoline by virtue of multiple products being transported in the same pipelines and trucks. Given the mobility of MTBE, the Case Manager has the authority to require persons to analyze samples for this constituent should site conditions and potential receptors warrant this information.

NOTE: Case Managers may wish to obtain information about MTBE when a potable water supply well may be impacted by the release.

## **AA.4 Diesel**

According to Irwin et al (1997) and Chevron Products Company (1998), diesel fuel refers to those fuels that are intended for compression ignition engines. The product definition for diesel oil in the Toxic Substances Control Act is:

“A complex combination of hydrocarbons produced by the distillation of crude oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C9 – C20 and boiling in the range of approximately 163 to 357 degrees C.”

The three most common diesel fuels in the U.S. are: diesel oil #1 (grade 1-D); diesel oil #2 (grade 2-D); and diesel oil #4 (grade 4-D) (Whiticar et al 1993 and Chevron Products Company 1998). Number 1 diesel is the most volatile of the diesel fuels and is used in high performance engines that require good ignition characteristics (Block et al 1991). Number 1 diesel is often used in city buses (WHO 1989).

Number 2 diesel has a higher specific gravity than number 1 diesel and is used for industrial and heavy transportation service including trucks and railroads (WHO 1989). According to Chevron Products Company (1998), #2 diesel is the fuel most used by commercial vehicles in the U.S.

Number 4 diesel is the heaviest of the common diesel fuels (Chevron Products Company 1998) and is used for low and medium speed engines (WHO 1989).

### **AA.4.1 Product Chemistry of #2 diesel**

According to Block et al (1991), paraffins generally comprise approximately 65 to 85 percent of most diesel fuels. The branched alkanes pristane and phytane are often of particular interest due to their relatively high concentrations in diesel fuels and the ease with which they may be identified by gas chromatography. According to (Block et al 1991), the ratios of pristane to heptadecane and phytane to octadecane for a given source of diesel fuel are often sufficiently distinctive to allow source identification.

Aromatic compounds typically comprise 10 to 30 percent of #2 diesel fuel. The flash point specification for #2 diesel is high enough that only trace amounts of the BTEX constituents may be present in the fuel. PAHs found in diesel fuels include naphthalene, phenanthrene, acenaphthene, acenaphthylene, fluorene, fluoranthene, pyrene, 2-methylnaphthalene, benzanthracene, triphenylene, chrysene, benzo(a)pyrene, and benzo(e)pyrene (Calabrese and Kostecki 1991, Kangas et al 1994, Block et al 1991, Heath et al 1993). According to (Block et al 1991), the most predominant compounds in this class are naphthalene and methyl substituted naphthalenes.

NOTE: The lower flash point on #1 diesel may allow significant concentrations of the BTEX constituents in this fuel.

Diesel fuel also contains metals. Metals present in diesel may include the following:

Arsenic	up to .13 ppm
Cadmium	up to .89 ppm
Chromium	up to 2.8 ppm
Iron	up to 71 ppm
Lead	up to 2 ppm
Manganese	up to 6.2 ppm
Molybdenum	up to .27 ppm
Vanadium	up to 4.8 ppm
Zinc	up to 4.8 ppm

source: Oak Ridge National Laboratory 1989

## **AA.4.2 Diesel Additives**

According to Chevron Products Company (1998), additives placed in diesel fuel are generally related to improving: (a) engine performance; (b) fuel handling; (c) fuel stability; or (d) contaminant control. The most widely used ignition improver (i.e. cetane number improver) is 2-ethylhexyl nitrate (a.k.a. octyl nitrate) and this compound typically comprises approximately .05% of number 2 diesel by weight (Chevron Products Company 1998). Other additives found in diesel fuels include peroxides, organic compounds containing barium, calcium, manganese, or iron, organic antioxidants (e.g. phenylenediamine), ethylene vinyl chloride polymers, and chlorinated hydrocarbons used as cold flow improvers (Oak Ridge National Laboratory 1989 and Chevron Products Company 1998).

## **AA.4.3 Constituents of Concern in Diesel**

### **AA.4.3.1 Petroleum Hydrocarbons (TPH)**

Samples collected at diesel release sites routinely will be analyzed for TPH. The recommended analyses for TPH are GC based diesel range methods such as EPA Method 8015 for diesel range constituents, the California Method for diesel range constituents, and the Wisconsin DNR Method for diesel range constituents.

### **AA.4.3.2 PAHs**

Many of the lighter PAHs are present in diesel fuel and information about PAH concentrations is important when assessing risks from a diesel release. EPA Methods 8270C, 8100, 8310, 610, and 625 may be used to analyze samples for PAHs.



#### AA.4.3.3 BTEX

The boiling range for #2 diesel greatly inhibits the amount of BTEX constituents that may be present in the fuel. Given the limited amount of BTEX constituents that is expected to be present in #2 diesel, information about these constituents is not expected to be necessary at all diesel release sites. The DEQ Regional Case Manager has the option of requiring BTEX analyses if this information is believed necessary to evaluate risks at a site. In most instances, Case Managers will probably require BTEX analyses when ingestion of contaminated ground water is a pathway of concern at a site.

#### AA.4.3.4 MTBE

MTBE is not an additive of diesel fuel. This constituent may, however, be found in small concentrations in petroleum products other than gasoline by virtue of multiple products being transported in the same pipelines and trucks. Given the mobility of MTBE, the Case Manager has the authority to require persons to analyze samples for this constituent should site conditions and potential receptors warrant this information.

NOTE: Case Managers may wish to obtain information about MTBE when a potable water supply well may be impacted by the release.

### **AA.5 #2 Fuel Oil (Home Heating Oil)**

#### **AA.5.1 Uses and General Information**

Diesel fuels and home heating oil are forms of #2 fuel oil and are similar in composition with the exception of additives (Micromedex 1993, Whiticar et al 1993, and ATSDR 1993). Number 2 fuel is intended for use in atomizing type burners (Irwin et al 1997). Heating distillate grade number 2 is the fuel most commonly used in residential heating. This fuel is also commonly used in many medium capacity industrial burners (Curl and O'Donnell 1977).

Number 2 fuel oil is usually a blend of straight-run and catalytically cracked distillates. The dominant compounds in number 2 fuels have from 11 to 20 carbon atoms (WHO 1989) with an average carbon number of 15 per molecule (Curl and O'Donnell 1977). According to Curl and O'Donnell (1977), the average chemical composition of #2 fuel oil is 30 percent paraffins, 45 percent naphthenes, and 25 percent aromatics. Number 2 fuel oil created mostly from atmospheric distillate streams typically contains less than five percent of the three to seven ring PAHs. If a high proportion of the fuel oil was derived from heavy atmospheric, vacuum or light cracked distillates, the concentration of three to seven ring PAHs present may be as high as 10 percent (WHO 1989).

## **AA.5.2        Constituents of Concern in #2 Fuel Oil**

### AA.5.2.1        Petroleum Hydrocarbons (TPH)

Samples collected when #2 fuel oil is released routinely will be analyzed for TPH. The recommended analyses for TPH are GC based diesel range methods such as EPA Method 8015 for diesel range constituents, the California Method for diesel range constituents, and the Wisconsin DNR Method for diesel range constituents.

### AA.5.2.2        PAHs

Many of the lighter PAHs are present in #2 fuel oil and information about PAH concentrations is important when assessing risks from a diesel release. EPA Methods 8270C, 8100, 8310, 610, and 625 may be used to analyze samples for PAHs.

### AA.5.2.3        BTEX

The boiling range for #2 fuel oil greatly inhibits the amount of BTEX constituents that may be present in the fuel. Given the limited amount of BTEX constituents that is expected to be present in #2 fuel oil, information about these constituents is not expected to be necessary at all diesel release sites. The DEQ Regional Case Manager has the option of requiring BTEX analyses if this information is believed necessary to evaluate risks at a site. In most instances, Case Managers will probably require BTEX analyses when ingestion of contaminated ground water is a pathway of concern at a site.

### AA.5.2.4        MTBE

MTBE is not an additive that is intentionally placed in fuel oils. This constituent may, however, be found in small concentrations in petroleum products other than gasoline by virtue of multiple products being transported in the same pipelines and trucks. Given the mobility of MTBE, the Case Manager has the authority to require persons to analyze samples for this constituent should site conditions and potential receptors warrant this information.

NOTE: Case Managers may wish to obtain information about MTBE when a potable water supply well may be impacted by the release.

## **AA.6 #4 Fuel Oil**

### **AA.6.1 General Information**

Fuel oils #4, #5, and #6 are commonly known as residual fuel oils since they are manufactured from distillation residues from refinery processing (WHO 1989). Fuel oil #4 is a heavier distillate fuel than #2 fuel, but is lighter than #5. Fuel oil #4 may be prepared as a high boiling distillate or light residual of crude oil or it may be prepared by combining 40% #2 fuel oil with 60% #6 fuel oil (Curl and O'Donnell 1977).

Fuel oil #4 is used in atomizing type burners that atomize oils of higher viscosity than domestic burners can manage. The permissible viscosity range of #4 fuel oil allow this product to be pumped and atomized at relatively low storage temperatures thereby, making it unnecessary to pre-heat this product (Curl and O'Donnell 1977).

Fuel oil #4 is composed of hydrocarbons primarily ranging from C19 to C25 (ASTM 1995). As with the other residual oils, #4 fuel oil is a complex mixture of relatively high molecular weight compounds including asphaltenes, polar aromatics, naphthalene aromatics, aromatics, saturated hydrocarbons and heteromolecules containing sulfur, oxygen, nitrogen, and metals (WHO 1989). According to WHO (1989), appreciable concentrations of PAHs are present in residual fuels because of the common practice of using both uncracked and cracked residues in the process of manufacturing this product. Most blending stocks of residual fuel oils contain at least 5 percent of the four to six ring PAHs. The exact identities and concentrations of these PAHs depend on the nature and amount of the low viscosity blending stocks and the proportions of virgin and cracked residues (WHO 1989). Additives placed in #4 fuel oil to improve combustion often include oil soluble compounds containing calcium, cerium, iron, or manganese (WHO 1989). Aromatic compounds typically comprise 15 to 40 percent of the residual fuel oils and most of these aromatics present in #4 oil are alkyl phenanthrenes and naphthalenes (ASTM 1995). PAHs expected to be present in both #4 and #5 fuel oils include:

Naphthalene	Benzo(b)fluoranthene
Biphenyl	Benzo(k)fluoranthene
Acenaphthylene	Benzo(e)pyrene
Acenaphthene	Benzo(a)pyrene
Fluorene	Perylene
Anthracene	Indeno(1,2,3-c,d)pyrene
Phenanthrene	Dibenz(a,h)anthracene
Dibenzothiophene	Benzo(g,h,i)perylene
Fluoroanthene	
Pyrene	(Irwin et al 1997)
Benzo(a)anthracene	
Chrysene	

## **AA.6.2      Constituents of Concern in the Residual Fuel Oils (#4, 5, and 6)**

### **AA.6.2.1      Petroleum Hydrocarbons (TPH)**

Samples collected when residual fuel oils are released routinely will be analyzed for TPH. Given the heavy hydrocarbon compounds present in these fuels, analytical methods that can detect heavier hydrocarbons such as EPA Methods 418.1, 413.2, and 1664 and the Wisconsin TRPH Method are expected to be the most appropriate methods for these fuels. Diesel range GC methods may be acceptable for releases of #4 fuel oil if the method used can detect hydrocarbons up to around C28.

### **AA.6.2.2      PAHs**

Many of the PAHs are present in the residual fuel oils and information about PAH concentrations is important when assessing risks following a release of one of these products. EPA Methods 8270C, 8100, 8310, 610, and 625 may be used to analyze samples for PAHs.

## **AA.7      #5 Fuel Oil**

Number 5 fuel oil consists of straight run and cracked distillates and residuals and contains aliphatics and aromatics (Dabney 1994). According to Sullivan and Johnson (1993), #5 fuel oil is usually produced by blending #6 fuel oil with lighter distillate fractions. According to Curl and O'Donnell (1977), #5 fuel oil is typically comprised of 75 to 80 percent #6 oil and 20 to 25 percent lighter distillate fractions. ASTM specifications list two grades of #5 fuel oil; "light" and "heavy." Light #5 fuel oil is a residual oil of intermediate viscosity that is used in burners capable of handling fuel more viscous than #4 without preheating (Curl and O'Donnell 1977). Heavy #5 fuel oil is a residual fuel oil that is more viscous than light #5 and must usually be preheated to between 170 and 220 degrees Fahrenheit before handling or use (Curl and O'Donnell 1977). Number 5 fuel oil sometimes is referred to as Bunker B fuel (Micromedex 1993).

NOTE: Light number 5 fuel oil may need to be preheated depending upon the type of equipment used and the climatic conditions.

Aromatic compounds typically comprise 15 to 40 percent of the residual fuel oils (Curl and O'Donnell 1977). PAHs usually present in #4 and #5 fuel oils are listed under the #4 fuel oil section above.

## **AA.8 #6 Fuel Oil**

Number 6 fuel oil is a heavy, residual fuel oil most commonly used in industrial boilers. Number six fuel oil must be heated before use. According to Potter and Simmons (1998), #6 fuel oil is composed of hydrocarbons having from approximately 18 carbon atoms to greater than 34 carbon atoms. See the entry for #4 fuel oil for the primary constituents of concern and analytical methods.

## **AA.9 Mineral Spirits, Paint Thinner, Varsol®, Stoddard Solvent**

According to the Total Petroleum Hydrocarbon Work Group (1998), petroleum naphtha is a generic term for a variety of refined or unrefined petroleum products in the C6 to C12 range. Different naphthas can be all aromatic, all paraffinic, aromatic/paraffinic combinations, or aromatic compounds such as xylenes, etc. "Mineral spirits" is a common synonym for naphtha. According to (Custance et al 1993), mineral spirits are derived from the light distillate fractions during the crude oil refining process and are composed of the C6 to C11 compounds, with the majority of the compounds in the C9 to C11 range. Stoddard solvent is a commonly used mineral spirit that is in the C8 to C12 range. Naphthas are widely used as paint thinners and solvents and may be used in cutback asphalt and in various extraction processes. Paint thinners, in addition to containing mineral spirits and turpentine may also contain toluene and ethyl acetate (EPA).

### **AA.9.1 Chemical and Physical Properties of Mineral Spirits and Stoddard Solvent**

Mineral spirits are composed of the following general classes of compounds:

- 20 to 65 percent paraffins (alkanes)
- 15 to 40 percent cycloparaffins (cyclic alkanes)
- 10 to 30 percent aromatics (Whitcar et al 1993, WHO 1989).

According to (ATSDR 1995), Stoddard solvent, a specific type of mineral spirit, contains the following percentages of hydrocarbons:

- 30 to 62 percent paraffins (alkanes)
- 27 to 40 percent cycloparaffins (cyclic alkanes)
- .3 to 20 percent alkylbenzenes
- .007 to .1 percent other benzenes

Physical properties of mineral spirits include:

- Aqueous solubility – 45.88 mg/l (Custance et al 1993)
- Vapor pressure – 2.53 mm HG (Custance et al 1993)
- Henry's Law Constant – 1.03 E-2 atm-m<sup>3</sup>/mol
- Density - .8040 at 0 degrees C
- .7786 at 20 degrees C
- Boiling Range: mineral spirits – 150 to 200 degrees C
- Stoddard solvent – 160 to 210 degrees C

## **AA.9.2 Analytical Methods Recommended for Mineral Spirits, Stoddard Solvent, and Naphthas**

A site assessment guide published by the Michigan Department of Environmental Quality recommends that EPA Method 8260 be used for mineral spirits, stoddard solvents, and naphthas. The North Carolina Department of Natural Resources requires persons to analyze samples by the methods listed below when naphtha, Varsol®, and/or mineral spirits are the products of concern:

- EPA 602 + xylenes
- Massachusetts Dept. Of Env. Protection VPH
- Massachusetts Dept. Of Env. Protection EPH
- EPA 625 + the 10 largest non-target peaks

Petroleum hydrocarbon analytical methods for gasoline range organics typically detect hydrocarbons up to approximately C10. The diesel range methods typically detect constituents from approximately C10/C12 to C24/C28 depending upon the method and the lab. The methods recommended by other states combined with the predominant carbon range for naphtha and related products suggest that the gasoline range TPH methods are the most appropriate analytical methods for these products. Petroleum naphtha and related products may contain aromatic hydrocarbons (i.e. BTEX constituents) and if the release may pose a risk to receptors, staff should determine if the BTEX constituents pose a risk at the site.

Appropriate TPH Analyses for mineral spirits, Varsol®, paint thinner, and stoddard solvent include the California LUFT Method for TPH (gasoline range), the Wisconsin DNR Method for TPH (gasoline range), and EPA Method 8015B (TPH - GRO).

## **AA.10 Motor oil**

### **AA.10.1 General Information**

Motor oil is composed primarily of hydrocarbons in the C20 to C34 range that are left over after the removal of lighter fractions by distillation (Michigan DEQ 1999). According to EPA, motor oil is composed of approximately 75 percent mineral oil, 20 percent oxidation inhibitors and detergents, and 5 percent pour depressants and viscosity improvers. Irwin et al (1997) indicates that fresh motor oil consists of 80 to 90 percent hydrocarbons and 10 to 20 percent performance enhancing additives. Motor oil is altered during use because of the breakdown of additives, contamination with the products of combustion, and the addition of metals from engine wear (Irwin et al 1997). Used motor oil evaluated by Upshall et al (1993) contained 14 percent aromatics and 65 percent aliphatics by weight. The concentration of PAHs is also much higher in used oil than in fresh motor oil (Upshall et al 1993). Used motor oil also may contain significant concentrations of metals including lead, calcium, zinc, and magnesium (Whiticar et al 1993).

## **AA.10.2      Constituents of Concern in Motor Oil**

### **AA.10.2.1      Petroleum Hydrocarbons (TPH)**

Given the dominant petroleum hydrocarbon range of motor oil, TPH methods designed for heavy oils are the methods of preference. Appropriate methods include EPA Methods 418.1, 413.2, 1664<sup>1</sup>, and Wisconsin TRPH.

### **AA.10.2.2      BTEX**

Given its specifications and hydrocarbon range, new motor oil is not expected to contain the BTEX constituents. Used motor oil, however, may be contaminated with any number of other materials including gasoline. DEQ Case Managers have the option of requiring RPs to analyze samples for BTEX should they believe that potential risks and site-specific conditions warrant this information.

### **AA.10.2.3      PAHs**

PAHs may be present in new motor oil and are present in significant concentrations in used motor oil. Information about PAHs is often needed in order to assess risks following a release of motor oil.

### **AA.10.2.4      Lead**

Lead is highly toxic and may be present in significant concentrations in used motor oil. Information about the concentration of lead in soil may be needed to assess risks if persons may come into contact with contaminants on the ground surface.

## **AA.11      Transmission fluid and hydraulic oil**

Transmission and hydraulic fluid are predominantly composed of mineral oils. Transmission fluid also may contain glycols and zinc compounds. Given the hydrocarbon range for lubricating oil, the most appropriate TPH analytical methods to use for transmission fluid and hydraulic oil are Methods 418.1, 413.2, 1664, and Wisconsin DNR TRPH. The DEQ Case Manager has the option of requiring other analyses if site specific conditions and potential risks warrant the additional information. Case Managers may wish to direct the RP to analyze samples for glycols and PAHs if receptors will or are likely to come into contact with these products.

## **AA.12 Mineral Oil**

Mineral oil is a highly refined oil that consists of saturated hydrocarbons (Calabrese and Kostecki 1991). The Massachusetts Toxic Substances list contains 25 substances containing the phrase “mineral oil” and each of these substances has a different Chemical Abstract Service (CAS) number. Mineral oil is generally considered to be a lubricating oil and the constituents in lubricating oil generally range from C20 to C45 compounds (Sullivan and Johnson 1993)

According to Merck (1983), mineral oil is a colorless oily liquid. Reported densities for mineral oil range from approximately .82 g/ml to 1.001 g/ml depending upon the oil and the temperature (Whiticar et al 1993, NLM 1994). Mineral oil consists mostly of saturated hydrocarbons, but also may contain PAHs (NLM 1994). According to Irwin et al (1997), some of the mineral oils used to lubricate cutting lathes have been associated with occupational cancer in machine shop workers.

Potential constituents of concern following releases of mineral oil into the environment include PAHs and petroleum hydrocarbons. Given the hydrocarbon range for lubricating oil, the most appropriate TPH analytical methods to use for mineral oil are Methods 418.1, 413.2, 1664, and Wisconsin DNR TRPH.

## **AA.13 Antifreeze**

Antifreeze is not a petroleum product. Antifreeze usually would be considered a regulated substance because the predominant ingredient in most types of antifreeze is ethylene glycol. According to EPA SW 846, the most appropriate methods for ethylene glycol are EPA Method 8015 (request that the lab specify ethylene glycol concentration) and EPA Method 8430.

## **AA.14 Ethanol**

Ethanol (grain alcohol) is not a petroleum product. Ethanol may be used as an oxygenate in gasoline although its use is not nearly as widespread as that of MTBE. According to SW 846, the most appropriate methods for ethanol are EPA Method 8015 (request that the lab specify the ethanol concentration) and EPA Method 8260.

<sup>1</sup> The detection limit for Method 1664 is presently on the order of 5 mg/l. DEQ Case Managers, responsible persons, and/or consultants should consider the the site specific data requirements when determining the appropriateness of this method.



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## **APPENDIX AB**

### **Applicability of Article 11 to discharges of CERCLA regulated substances**

## **Applicability of Article 11 to discharges of CERCLA regulated substances**

Facilities utilizing or otherwise managing CERCLA hazardous substances (i.e. substances defined in §101(14) of CERCLA) may have releases of those substances from above ground storage tanks or other management units. This memorandum discusses the applicability of Article 11 of Virginia Water Control Law to releases of these CERCLA defined hazardous substances.

### **Issue Statement**

Facilities utilizing or otherwise managing CERCLA hazardous substances may have releases of those substances into the environment. Most of these releases are not of the scope where they will be ranked and placed on the Superfund National Priorities List. Releases of CERCLA hazardous substances from regulated USTs are subject to the corrective action requirements of the UST Technical Regulation. Many releases of CERCLA hazardous substances, however, are from management units or structures other than USTs and questions have been raised regarding the applicability of Article 11 to the cleanup of CERCLA hazardous substances from sources other than regulated USTs.

### **Discussion**

Article 11 of Virginia Water Control Law applies to the discharge of oil to Virginia waters, lands, or storm sewers. Oil, under Article 11, means:

“oil of any kind and in any form, including, but not limited to, petroleum and petroleum by-products, fuel oil, lubricating oils, sludge, oil refuse, oil mixed with other wastes, crude oils and all other liquid hydrocarbons regardless of specific gravity.”

This definition of oil has created confusion about the applicability of Article 11 to hydrocarbon liquids (e.g. toluene) that are also CERCLA hazardous substances. Historically, the DEQ and the State Water Control Board have considered CERCLA hazardous substances and “oil” to be separate classes of materials despite the broad definition of “oil” listed in Article 11 (and its predecessor, Article 8). Reasons for this interpretation and application of Virginia Water Control Law as it relates to oil include (1) an informal opinion from the Attorney General’s Office (1979); (2) the distinction made between “oil” and “hazardous substance” in the Clean Water Act and Federal Water Regulation; and (3) the distinction made between “petroleum” and “hazardous substance” in CERCLA and RCRA.

### Opinion from the Virginia Attorney General's Office

In the late 1970's, the State Water Control Board requested that the Attorney General's Office provide an interpretation of the definition of "oil" in Article 8; a law that was repealed and replaced by Article 11 in 1990. The definition of "oil" in Article 8 also contained the phrase "all other liquid hydrocarbons regardless of specific gravity." The Assistant Attorney General responded to the request and stated that the term "all liquid hydrocarbons" covers a large number of chemicals that are not considered "oils" as that term is commonly understood. Moreover, the Assistant Attorney General also stated a belief that the General Assembly did not intend to accomplish wholesale regulation of toxic substance spills by means of Article 8. The Assistant Attorney General made the following recommendation:

"I would recommend that you (Executive Secretary of the State Water Control Board) instruct them (State Water Control Board Staff) to regard the law as covering all types of oil as the term is commonly defined, including petroleum and its products such as gasoline, kerosene, fuel oils, lubricating oils, crude oils, waste oil and grease, vegetable oils and animal oils, and synthetic oils. Where there is a spill of a "liquid hydrocarbon" not included in the above-listed materials, the staff, with guidance from State Water Control Board headquarters and, if necessary, this office, must determine whether or not it may arrange for removal of the substance (if it is removable) according to the provisions of Article 8. It should be kept in mind that oil and hazardous substances are treated distinctly in § 311 of the Clean Water Act ..."

### Clean Water Act

The Clean Water Act defines oil as "oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredge spoil." Hazardous substances are defined separately from oil within the Clean Water Act and exclude oil. Hazardous substances listed in the Federal Water Regulations include chemicals or constituents found in crude oil and petroleum products including benzene, toluene, xylenes, and naphthalene.

### CERCLA and RCRA

Distinctions are made between petroleum and hazardous substances within both CERCLA and RCRA. The term "hazardous substance" in CERCLA means:

"(A) any substance designated pursuant to section 1321(b)(2)(A) of title 11, (B) any element, compound, mixture, solution, or substance designated pursuant to section 9602 of this title, (C) any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (42 USC 6921)(but not any waste the regulation of which under the Solid Waste Disposal Act (42 USC 6901 et seq.) has been suspended by Act of Congress), (D) any toxic pollutant listed under section 1317(a) of title 33, (E) any hazardous air pollutant listed under section 112 of the Clean Air Act (42 USC

7412), and (F) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 2606 of title 15. The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and synthetic gas).”

Subtitle I of RCRA separates “regulated substances” into the categories of “hazardous substances” and “petroleum.” Hazardous substances are those substances defined as hazardous substances under CERCLA (see definition in the previous section).

## **Summary and Recommendations**

Although the term “oil” is defined very broadly in Article 11 and may be interpreted to include any liquid hydrocarbon, this broad interpretation is inconsistent with recommendations from the Attorney General's Office and Federal and state environmental laws. The DEQ Storage Tank Program believes that it is appropriate to make a distinction between oils and listed hazardous substances and shall, therefore, consider those materials, chemicals, and products defined in § 101(14) of CERCLA to be hazardous substances and not oil. The DEQ Storage Tank Program will not consider discharges of substances defined in § 101(14) of CERCLA to be subject to the requirements of Article 11 of Virginia Water Control Law. The Storage Tank Program expects that most discharges of these CERCLA listed substances will be addressed through the Superfund or Voluntary Remediation Programs. Only those releases of CERCLA listed substances from USTs subject to the requirements of Article 9 of Virginia Water Control Law and the Virginia UST Technical Regulation will be addressed by the Storage Tank Program.

In order to determine if a material is a hazardous substance, staff should refer to the SARA Title III List of Lists (Appendix A of the Storage Tank Program Technical Manual). Materials, chemicals, and substances placed in the List of Lists are CERCLA hazardous substances and will not be considered petroleum products or oils by the DEQ Storage Tank Program.

## **APPENDIX AC**

### **Small Heating Oil Tank Release Characterization Report Form**



## SMALL HEATING OIL TANK RELEASE CHARACTERIZATION REPORT FORM

**Instructions:** This form may be used only for reporting investigation and corrective actions at Category 1 sites with releases from heating oil tanks with a capacity of 1,000 gallons or less and no impacted water supply wells within 500 feet or impacted surface water bodies within 200 feet of the leaking tank.

A. <b>PC Number:</b>	B. <b>Date Reported:</b>	C. <b>DEQ Region:</b>
D. <b>Tank Owner:</b>	E. <b>Site Address:</b>	
F. <b>Tank Owner's Phone:</b>	G. <b>DEQ Case Manager:</b>	

H. <b>Soil Sample Results: Attach a copy of all lab reports. Include sample depth in description.</b>		
Sample 1 Description: _____	Method: _____	Results: _____
Sample 2 Description: _____	Method: _____	Results: _____
Sample 3 Description: _____	Method: _____	Results: _____
Sample 4 Description: _____	Method: _____	Results: _____
Sample 5 Description: _____	Method: _____	Results: _____

I. <b>Water Sample Results: Attach a copy of all lab reports.</b>		
Sample 1 Description: _____	Method: _____	Results: _____
Sample 2 Description: _____	Method: _____	Results: _____
Sample 3 Description: _____	Method: _____	Results: _____

J. <b>How was the release discovered? If known, estimate amount of product lost .</b>

K. <b>Receptor Survey</b>
Evaluate the risk to any surface water bodies within 200 feet of the release.
Is the area served by public water? <input type="checkbox"/> <b>YES</b> <input type="checkbox"/> <b>NO</b>
Evaluate the risk to drinking water wells located within 500 feet of the release. For all wells, describe the distance from the release, topographic location from the release, depth, and construction. Provide general geologic information and soil types at the release site.

**K. Receptor Survey – Continued**

Was recoverable free product or a significant volume of saturated soil encountered? ☐ **YES** ☐ **NO**

Does the building at the release site or adjacent properties have a basement, sump, or crawl space? ☐ **YES** ☐ **NO**

Were any of the basements, sump, or crawl spaces impacted? ☐ **YES** ☐ **NO** If yes, identify them on the attached location map and provide details below.

**L. Additional Information or Comments**

**Attach the following items to this report. The report will not be considered complete without each of these items.**

1. A location map of the site with street names and release site address. Note all sampling points, tank location, and distance to potential receptors on the map. The map does not need to be to scale and may be neatly drawn by hand.
2. Lab reports for all samples listed above
3. Small Heating Oil Tank AAF
4. Hand auger boring log
5. Topographic map
6. Site photos (recommended)
7. Local Permits, if applicable

Consultant's Signature: \_\_\_\_\_

Date: \_\_\_\_\_